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Vol. X, Nos. 1—4 January—December, 1958

DIRECTORATE OF PLANT PROTECTION, QUARANTINE & STORAGE
MINISTRY OF FOOD & AGRICULTURE, GOVERNMENT OF INDIA

PLANT PROTECTION BULLETIN

SCIENCE IN PRACTICE

COMMONWEALTH INST.
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Issued by the
PLANT PROTECTION ADVISER TO THE GOVERNMENT OF INDIA,
NEW DELHI

1961

DPP. 2. X. 1–4
400

Published in a single combined issue

		Inland	Foreign
Sale Price :	per copy	Rs. 3.25 nP.	5 *sh.* 3 *d.*

Available from
THE MANAGER OF PUBLICATIONS, CIVIL LINES, DELHI—8

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PRINTED IN INDIA BY THE MANAGER, GOVERNMENT OF INDIA PRESS, FARIDABAD AND PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI, 1961

NOTE

This Bulletin is intended to disseminate information about plant protection measures and campaigns, adopted or conducted in different parts of India, as well as about the advances made in the field of plant protection in other parts of the world to the extent possible. It is also intended to give information about the latest developments in the production and use of pesticides and plant protection equipment as well as about techniques of pest and plant disease control. Elaborate scientific papers on Entomology or Plant Pathology or on the chemistry of pesticides would normally not be in place in this Bulletin but short notes dealing with the behaviour or distribution of pests and plant diseases and brief reports on their epidemiology, control, etc., would be welcome. Plant protection has now become such a specialised science and yet is so diversified and consequential in its character and application that it is difficult to define the scope of the subject with any great precision. The general rule to be observed is that any information which can be useful in preventing or controlling damage to crops, fruit trees, plantations and stored agricultural commodities, caused by pests and diseases, should be a fit subject for publication in this Bulletin.

Manuscripts submitted for publication in the Plant Protection Bulletin must be typed in double spacing on one side of the paper only, leaving ample margin on the left, at the bottom and on the top of the page. Photographs or drawings must be accompanied by a clearly typed legend for being reproduced under them. In addition, they should bear, on the reverse, in clear handwriting in pencil, the name or names of the author or authors and the article which they illustrate. Local names of insects, diseases, weeds, crops and plants, if used, must be commenced with a small, not capital, letter and underlined and must invariably be followed by their scientific or well known English names. Localities or place names should be clearly indicated by reference to well known districts or States or both.

While this Directorate will take every care to include only such material in the Bulletin as may be considered reasonably correct and useful, it can accept no responsibility for every statement made and every opinion expressed. Due to various unavoidable reasons, the appearance of this Bulletin has been far behind the scheduled time. While this must be greatly regretted, every effort would be made to avoid delays in future. Those who may read this Bulletin are invited to offer criticisms and suggestions for its improvement.

K. B. LAL,

New Delhi

PLANT PROTECTION ADVISER TO THE GOVERNMENT OF INDIA

RAT MENACE IN ASSAM

By

K. B. Lal,

Plant Protection Adviser to the Government of India, New Delhi.

Rats damage crops and stored products everywhere in India but this year (1958) they have acquired a special significance in Assam on account of the flowering of bamboos, which started in September or October, 1957, in the Lushai hills, notably in the Aijal subdivision of the Mizo district. The flowering of bamboos has also been observed in the Kameng Frontier Division of NEFA and in certain areas in Tripura. Pear-shaped and pear-sized, greyish green fruits of bamboos have also appeared in the Lushai hills. Bamboos have been known to flower every 50 years or so, though some species of bamboo may flower every 11 or multiple of 11 years or so. After the fruiting, the bamboos die completely and the event in Assam is known as *Mau Tam,* which means death of bamboos.

The people of Assam believe that the flowering of bamboos is followed by an abnormal increase of rats which is ascribed to an increase in their fecundity as a result of their feeding on bamboo fruits. The rats destroy paddy crop, sometimes over large areas even during one night. In the Lushai hills and other parts of Assam, the shifting (*Jhoom*) cultivation of paddy is in close proximity to bamboo forests and the rats turn their attention to the crop after having fed on bamboo flowers and fruits.

The destruction of paddy crop is naturally followed by a famine which is said to be preceded by four symptoms, namely, (i) flowering and fruiting of bamboos, (ii) abnormal increase of *thangnang* (a kind of flying insect), (iii) abnormal increase of jungle fowls and (iv) abnormally good crop. These premonitions of the people are based on the previous two bamboo flowerings, which occurred in 1860—62 and 1909—11, both of which were followed by severe famines. Records show that during 1910—12 the Government of Assam spent Rs. 1,532.60 in rewards for killing rats and about 1,79,015 rats were reported killed. It is said that all the four symptoms mentioned above are beginning to be noticed during this year. The bamboos have flowered and fruited, the *thangnang* insect has appeared in large numbers, jungle fowls have increased abnormally and the paddy crop in Mizo district was above normal in many areas in 1957. It is, therefore, feared that the wholesale destruction of paddy crop may start some time in 1958 or 1959 and continue till 1960.

There are 9 species of rats, 7 of mice, two each of gerbils and bandicoots, known from the Indian region, the latter two being closely allied to the rats. Of the rats, three species are commonly known respectively as Bay Bamboo rat, Hoary Bamboo rat and Large Bamboo rat, which are said to inhabit the eastern regions (Assam, south Tibet and Sikkim, Manipur, Tripura, Burma, south China, Thailand, etc.). One or more species of these rats may be the natives of Assam and neighbouring areas. However, their specific differentiation on scientific grounds is only of academic interest and makes no difference to the methods of rat destruction, that may be followed.

It is not clear as to whether the rats eat bamboo flowers or fruits or both. Nor is there any scientific evidence to prove that the eating of bamboo fruits by rats leads to greater reproduction in them. Since these questions can have some bearing on the methods of anti-rat campaigns, investigations should be undertaken to determine—

(*i*) Whether the rats feed on bamboo flowers or fruit or both,

(*ii*) If so, whether the flowers or fruits or both are eaten only under starvation conditions, reluctantly or with avidity and whether any marked preferences can be observed, and

(*iii*) Whether a bamboo flower or fruit diet enhances fecundity as determined by the rate of sexual maturity, frequency of broods during a period and the number of rats in a litter.

Steps have been taken by the Assam Government, in collaboration with the Directorate of Plant Protection, Quarantine and Storage, to organise extensive control campaigns against the rats.

OCCURRENCE OF TWO MORE INTRODUCED PESTS IN INDIA

By

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Introduction

The wide distribution in India of two notorious, introduced pests, the San Jose scale (*Quadraspidiotus perniciosus* Comstock) and the fluted scale (*Icerya purchasi* Maskell) was brought to light by a survey undertaken by the author during the years 1943—46.[1 2 3]

The occurrence in India of two more important insect pests of foreign origin has been reported. However, this appears to be at present insufficiently known, although in other countries where these pests occur, they are dreaded, and because of the enormous losses caused, all possible steps are being taken to control them and to prevent their further spread by legislation and domestic quarantines. These pests are the European corn borer, *Pyrausta nubilalis* Hubner and the gypsy moth, *Lymantria dispar* Linnaeus. *P. nubilalis* is reported to have been collected by Hampson[4] from Manipur, Khasis, Sikkim and north western Himalayas. Specimens of the species collected from Bihar, Punjab and Mysore in 1907, 1887—91 and 1915 respectively are present in the British Museum[5]. *L. dispar* has been reported from Kashmir[6] and specimens of the species collected in Punjab during 1938 exist in the British Museum[7]. In the Pusa collection in India, specimens of *P. nubilalis* collected only at Shillong, Khasi Hills, Kurseong and Turzum Tea Estate, Nagrispur, exist, while specimens of the gypsy moth are not available at all. Specimens of the latter insect are also not available in the collection of the Forest Research Institute, Dehra Dun. The very limited knowledge of these pests is probably partly due to their present very limited distribution and partly due to their being mistaken for some other, commonly known, allied, indigenous species. They are little known, however, mainly because there is a lack of sustained effort for surveying insect pests in this country. It appears that the European corn borer is being mistaken for one of the more common stem borers, like *Chilo zonellus* Swinhoe, while the gypsy moth may be confused with some other Lymantrid moths. At the same time, it is also possible that under the name *P. nubilalis* several species are at present confused, and existing records of the species cannot be confirmed until much more material, collected from all over India, is examined, while records of the species *L. dispar* may be based erroneously on specimens of *L. obfuscata* Walker.

The European Corn Borer

Distribution.—This pest is at present distributed over the greater part of Europe, where it probably originated, in Ceylon, China, India, Indonesia, Japan, Korea, Lebanon, Malaya, Manchuria, Pakistan, Philippines, Siam and Turkey in Asia, the U.S.S.R., Cyrenaica and Egypt in Africa, U.S.A. and Canada in North America, Guatemala in Central America and the Islands of Guam and New Guinea in the Pacific. In North America, it has been known to be present only since 1917 and is believed to have been introduced in shipments of broom corn from Italy or Hungary in about 1908 or 1909, and has shown itself to be one of the most destructive insect pests of corn. By 1938 the insect had spread in the U.S.A., all over New England, south-ward along the East Coast to the States of Delaware and Maryland, over most of Pennsylvania, Ohio and Indiana and along the eastern border of Quebec, New Brunswick and Nova Scotia in Canada. By 1954 it had spread in 37 States east of the Rocky Mountains, which comprised most of the main corn-growing areas in U.S.A., while in Canada by 1950 it had spread to Manitoba, Ontario, Prince Edward Island and Saskatchewan. Its spread has been so rapid that in course of time, it is likely to be distributed all over the corn-growing areas of North America.

Host Plants.—The European corn borer attacks nearly all herbaceous plants large enough for the caterpillar to enter. In the middle west of the U.S.A. and in Ontario, Canada, the pest has a single generation a year and feeds almost entirely on corn, although some of the common weeds, vegetables, flowers and field crops are found infested when such plants are grown in close proximity to badly infested corn fields. In New England, U.S.A., the corn borer has two generations a year and feeds extensively on potatoes, beans, beets, celery, dahlias, asters, chrysanthemums, gladioli and many weeds as well, even when such plants are not associated with corn. Altogether it has been found on more than 200 kinds of plants in the U.S.A.

In most countries, the major cultivated crops attacked are corn, hops, millet, hemp and broom corn, but corn (maize) is the preferred host wherever available. Mugwort (*Artemisia vulgaris* L.) is the chief host in Belgium, and this and allied species are favoured hosts in northern France. Pigweed (*Amaranthus retroflexus* L.) is also a favoured host in France while in Hungary, maize, broom corn, millet and hemp are reported to be the principal crops attacked. Hosts of minor importance recorded in various parts of the world include oats, barley, cotton, rice, kafircorn, bean pods, sunflower, barnyard grass (*Echinochlos crusgalli* (L.)B), Giant reed (*Arundo donax* L.), Fuller's teasel (*Dipsacus fullonum* L.), Green fox tail (*Setaria* spp.), nettle (*Urtica* spp.), thistles (*Cirsium* spp.), ploughman's spikenard (*Inula conyza* DC), Stiff inula (*Inula* sp.), Common reed (*Phragmites communis* Trin), peterita (one of the cultivated strains of *Sorghum vulgare* Pers.), Garden orach (*Atriplex hortensis* L.), Tumble weed (*Amaranthus*

greecizens L.), wood amaranth (*Amaranthus* sp.), dock (*Rumex* spp.), *Picris spinula* Guss., grape vines and various grasses.

Economic Importance.—On account of the exceedingly varied host plants, the European corn borer is able to live and thrive in many localities where the favoured hosts are grown only in limited quantities. Its wide range of hosts enables the species to become established in a variety of climates and to build up large population reserves outside cultivated areas, the adults from which then migrate into the cultivations and infest them. When the pest was first found in Hungary on maize early in the nineteenth century it caused total destruction of the crop in some areas while the average loss was estimated to be at least one fourth of the yield. In France, where the pest has been known since 1831, the greatest injury is to maize in the southern part of the country, where from 20 to 60 per cent of the stalks may be infested by the larvae. Although in Italy the insect has been known since 1884, it was not regarded as a serious pest until 1924 when maize in certain localities was found to have an average stalk infestation of 15 to 80 per cent. In 1909, 55 per cent of the maize crop in certain fields in Guam was damaged and damage was also done to sorghums and rice. In Ontario, Canada, during the early years of its invasion, it caused very serious damage, some estimates being as high as 90 per cent of the corn crop in some fields.

The Gypsy Moth

Distribution.—This insect, which originated in Europe, is now reported to be distributed in Afghanistan, China, Formosa, India, Iraq, Israel, Japan, Korea, Lebanon, Persia, Syria, Tibet and Turkey in Asia, the U.S.S.R., Algeria, Morocco and Tunisia in Africa and in U.S.A. in North America.

Host Plants.—This species is one of the most serious pests of shade trees, both evergreen and deciduous, stripping the foliage and often causing death of the trees. The most favoured food plants are oak (*Quercus* spp.), apple (*Malus* spp.), willow (*Salix* spp.), linden (*Tilia* spp.), birch (*Betula* spp.) and aspen (*Populus* spp.). The older caterpillars feed also on various conifers. The species has been found to feed on a large variety of trees and shrubs, more than 500 different species of host plants being known in U.S.A.

Economic Importance.—The caterpillars feed voraciously on the leaves of the host plants and defoliate them quickly. As a result of repeated defoliation the growth of the tree is retarded and in severe attacks the trees may be sufficiently weakened and die. In the U.S.A., with a view to preventing the spread of the pest, the infested area has been under federal quarantine. In part of this regulated area suppressive measures are being carried out in co-operation with State and local agencies.

This pest has gained notoriety since its introduction from Europe into U.S.A. in about 1869 by a French naturalist in a small town near Boston (Massachussetts) to experiment on its potentiality from the point of view of silk production. One day he realized that some of these insects had escaped or been released accidentally. He killed all the caterpillars he could find in the neighbourhood and gave warning of what had occurred. Twenty years later the pest had become a serious nuisance in the neighbourhood, the larvae swarming in the houses, over the walls and side walks, besides defoliating the trees. As the local inhabitants had noticed a minor infestation of the pest for some years, they did not consider the caterpillars as anything extra-ordinary but merely that they were unusually numerous. However, it was soon discovered that they were caterpillars of the Gypsy Moth, a pest of shade trees in Europe. Very soon the infestation was traced to the accident which had occurred twenty years back. It has cost the State of Massachussetts more than a million dollars a year. Since the pest has now spread in the New England States as well as in Canada, where several small infestations in Quebec and New Brunswick have been reported and promptly dealt with from time to time, it may be stated that several million dollars have been spent on its control in America alone.

Conclusion

The above brief account of these two pests will show the immediate need for carrying out a careful survey in India for these pests, to study their exact distribution and to take such steps as are necessary for preventing their further spread, should it be proved that they occur extensively. This is of importance not only to India but also to other countries where the pests are not known to exist, particularly in South East Asia.

The author hopes that the publication of this article will stimulate entomologists in India to collect any insects looking like *P. nubilalis* and *L. dispar* from as many localities as possible and to send them to him for identification. It may also be of interest to find out the natural enemies of these pests in the restricted areas in which they are reported to exist in India, because such a survey has not been undertaken so far.

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WEEDS : THE ANCIENT ENEMY*

By

Sir E. John Russell, O.B.E., F.R.S., D.Sc.

It is not likely that it will ever be possible to grow crops completely free from weeds. They have so much in their favour. Being mostly native plants and surviving by natural selection, they are vastly more prolific in seed production than most of our crops. A barley plant may produce 40—50 seeds, but a poppy, as Sir Edward Salisbury has shown, produces an average of 17,000, fortunately not all viable in any one year. The older way of dealing with weeds was by cultivation, fallowing and hand-pulling. Then came the discovery, the result of two chance episodes that could never have been expected outside a cinema, that a weak solution of copper sulphate would kill charlock without much injury to the barley. This brought the problem of weed control within the purview of the chemists, and before long sulphuric acid and finally cyanamide were being used on weedy cereal crops and sodium chlorate and arsenicals for more drastic purposes. Various difficulties prevented wide adoption of chemical treatment, and for fifty years or more it was quite common to see fields of corn in June a blaze of scarlet and yellow.

The Swing to Organics

The years between the two world wars saw the beginning of a tremendous revolution in the British chemical industry, particularly in the development of technological organic chemistry, whereby almost any of the prodigious multitude of substances that a chemist can prepare on a small scale in the laboratory can, if desired, be made by the ton in the factory. Some of the large chemical organizations set up their own experimental stations to test the agricultural possibilities of these new products.

Organic substances have the great advantage over the simple inorganic substances in that they can be built up in families of similar pattern. Each member is quite distinct and differs from the others only in the number and arrangement of the atoms, or groups of atoms, of which it is composed. Some graduation of many of their properties can be made by systematically adding to or removing particular groups of atoms.

Some of these new products are plant poisons, but very different from the sulphate of copper to which farmers had long been accustomed. Sulphate of copper had to be used at the rate of about 15 lb. per acre, and it required 50 gallons of water; only 6—10 lb. were needed of DNC, one of the first of the organic poisons on the market,

*Reproduced from *Agriculture*, London, 1958, 65, 5-8

while its close relative, dinoseb, which came later, was so much more effective that only 1 lb. per acre was needed. Of course, much greater care is needed with these potent materials; at 3 lb. per acre, dinoseb may kill undersown clover.

Properly used, DNC is effective against many of the weeds of cereal crops, but it has definite limitations : it does not kill wild oats, black bent or other weed grasses; it cannot be used for leguminous crops, nor for cereal crops undersown with clovers. On the other hand, dinoseb applied as directed can safely be used on undersown cereals, winter beans, lucerne, peas, sainfoin and also, but only during the dormant season, on strawberries. These differences cannot yet be explained.

The newer poisons are far more effective for the selective control of weeds in crops than the old mineral ones : indeed sodium chlorate and arsenicals cannot be used at all for this purpose, but they are invaluable for keeping gravel paths clean because they persist so long. But the organic poisons do not. Having done their work they fade away, being decomposed by some of the soil organisms—which apparently manage to feed upon them, though how or why they acquired this character is a mystery.

When all is said and done, however, these substances are poisonous and can do harm, so proper care must be taken. Regulations for their use are laid down by the Ministry of Agriculture in accordance with the Agriculture (Poisonous Substances) Act of 1952, and farmers may find it more convenient to have them applied by contractors.

Hormone herbicides and Selectiveness

But these are now being displaced by another group of complex organic substances which have the advantage of being non-poisonous yet at least as effective. Its members are modelled on the growth-promoting substances found in plants, and they are sometimes referred to as "hormones" a name derived from a Greek word meaning "to urge on" because they stimulate some vital action in the plant or animal. The natural substance, which is a true plant hormone, is not a herbicide, but many of the modifications made by chemists are, and additions are constantly being made. These new herbicides overact their role as stimulants and upset some of the vital processes in the plant to such an extent that it dies ; not instantly, as when killed by a strong poison, but after an interval. Their most remarkable properties are their high degree of selectiveness, their potency against the plants they kill, and their non-poisonous nature. The provisions of the Act mentioned above do not apply to them.

The two best known chemicals in this class are MCPA and 2, 4—D. The former is the more popular in this country, the latter in the United States. There are some differences in their behaviour :

Dr. Woodford has pointed out that 2, 4—D has advantages over MCPA in destroying more weeds, but MCPA is safer—particularly in spring oats. Their remarkable control of some of the common weeds of cereal crops, when applied at rates of about 1 lb. per acre, rapidly brought them into favour, and millions of acres are treated each year. In Britain great areas of cereals, grass and other crops are sprayed, as are vast areas in the United States, and most of Canada's cereals and small seeds. Increasingly larger areas are being treated in Australia, South Africa and East Africa. A conference which I attended on herbicides held at the East African Agriculture and Forestry Research Organization in Kenya in January, 1957 revealed a large amount of promising experimental data obtained there. These herbicides were discovered in Britain and are manufactured here, forming a valuable export commodity.

Limitation

They do not, however, completely solve the weed problem; in fact they have the defects of their virtues. Being hormones, they affect the vital processes in all plants, whether crops or weeds. Their selectiveness simply means that they affect some plants far more than others, or can get into them more easily. Resistant crops escape harm if certain conditions about quantities per acre and stage of growth are satisfied. Wheat and barley are safe with MCPA or 2, 4—D used at the rate recommended and when the plants are at their six-leaf stage. But if the herbicides are applied earlier, or in larger quantities, there is a lively risk of deformed plants and loss of crop. Nor do they distinguish between crops and weeds. They destroy a number of broad-leaved weeds, but they equally destroy broad-leaved crops such as clover, peas, and lucerne.

Another limitation is that their selectiveness restricts their range of action; weeds that they do not kill can flourish better after some of their competitors are destroyed. Cleavers used to be associated mainly with winter wheat; now however on farms where MCPA, which does not affect them, is regularly used they have increased considerably in spring-sown corn. Some other important weeds escape MCPA and 2, 4—D, including the grasses and wild oats, the mayweeds and corn marigold. Considerable search is being made for herbicides that can deal with them.

Two near neighbours of MCPA, made by replacing the acetic acid group in the molecule by propionic and butyric acid groups respectively, are proving very useful. The propionic compound CMPP is much more toxic to cleavers than MCPA, and less likely to damage the cereal crops, so that it can be applied earlier with better chance of killing the weeds. Like MCPA, however, it damages clovers, and so cannot be used on undersown cereals. CP—1815, a mixture of MCPA and 2, 3, 6—TBA, also kills cleavers, but cannot be used on cereals so early. The butyric compound MCPB, first systematically studied by Professor Wain and his colleagues at Wye College, is free

from this limitation; it can be used not only where clovers are present but on other leguminous crops, including peas—one of the worst of all farm crops for harbouring weeds. Another of the butyric compounds, 2, 4—DB, is used widely for controlling weeds in lucerne. Both MCPB and 2, 4—DB have a larger margin of safety for use with cereals than MCPA and 2, 4—D, and they are less likely to cause deformity.*

Other Chemicals

In addition to the two great groups of poisons and hormones, there are a number of other substances of herbicidal value. They are of various chemical families, and their numbers are steadily increasing. Some are promising destroyers of grass and wild oats. Among these are certain complex nitrogen compound such as CDAA, which can be used in warm countries to kill grass in maize, groundnuts and soya beans ; and a substituted urea that kills grass in sugar beet, cotton and onions. At least one of these compounds does not destroy grass but simply stops its growth so that it remains perpetually short. This seemed a promising agent for keeping putting greens in order, but experiments at the St. Ives Station, Bingley, showed that it was unsuitable for this purpose, though it might be useful on road verges. Some can act in the soil, killing the weed seeds or seedlings before they emerge. TCA applied two weeks before sowing destroyed couch grass in the Rothamsted mangold field, and wild oats in sugar beet, peas and kale at Chesterford Park. Its relative, dalapon, also kills grasses but is applied to the foliage and not to the soil.

But the universal herbicide that will kill all weeds and spare all crops is not yet in sight, nor is it ever likely to be. More probably mixtures of herbicides with their appropriate auxiliaries will be devised to deal with particular aggregates of weeds, not attempting complete elimination which would be too costly, but sufficient reduction below the harmful level.

Intensified Research

Chemical weed control is advancing very rapidly, and more than 10,000 papers have been published on the subject in the last five years. Progress will become much faster when the mode of action of the various groups of herbicide is better known. This particular aspect is being investigated at the Oxford University Department of Agriculture by a team under Professor Blackman, and at Wye College by another team under Professor Wain, while Dr. Woodford and John Fryer and other colleagues at Oxford are studying many of the practical problems involved. Search for new products and improved methods of applications is continuously made at the I.C.I. Research Station at Jealott's Hill, where much of the subject originated, at the Plant

*For a fuller account of this important group of herbicides see Professor Wain's article in *Agriculture*, London, 1957, 63, 575-9.

Protection Research Station at Fernhurst, the Research Stations of Fisons at Chesterford Park, or Shell at Sittingbourne, and of other important industrial organizations.

Chemical aids for controlling weeds and other pests, and various phases of plant growth, will almost certainly require even higher standards of cultivation and general farm management. More knowledge of the chemical and biological properties of the various agents will be needed than the farmer can find time to acquire, and a considerable development of expert plant protection by specialist services seems likely. This will of course necessitate close observation and shrewd judgment by the farmer, for he will need to know with certainty when he is well served. Of the many problems that still remain, the most important is to discover what is the effect on the consumer of this chain of treatments by potent chemicals on crops at the various stages of their progression from the seed to the table. So far there is no evidence of any harm, but constant and entirely impartial watch by the health authorities will be necessary. An Advisory Committee has already been set up with this purpose.

PLANT PROTECTION IN MADRAS STATE

By

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Introduction

The Entomology Section of the Madras Agricultural Department was started in 1906 and has so far contributed not a little in the field of research and extension in crop protection. The earlier years were naturally devoted to the study of the bionomics of pests, their seasonal occurrence, distribution, etc. An exhaustive collection of type specimens, including crop pests, parasites and predators, has been built up, which can well be regarded as a national asset. Additions are being made year after year from material collected by the staff. Until recently, pest control work had been limited to the use of arsenical poisons, soap, oil emulsions and botanical insecticides like tobacco, pyrethrum and acorus. The availability of synthetic, organic chemicals from about 1946 was taken advantage of and suitable control measures have now been recommended for almost all external feeders of crops. Even in the case of borers, repeated applications of some of these pesticides have given a certain measure of relief. Trials with a variety of pesticides available in the market are also in progress with a view to advising farmers, extension agencies and others about the suitability of such pesticides.

The results of research were transmitted to the farmers through the agency of extension workers, designated as 'entomycology demonstrators' during the earlier years. An independent organisation exclusively for plant protection work was sanctioned in November, 1948, and continues to function under one of the schemes of the Second Five Year Plan. In this article a short account is given of the work of the Plant Protection organisation in Madras State.

Pesticides Recommended

The cultivators are now familiar with the two insecticides, DDT and BHC. Although both of them are effective against a wide range of insects, it may be pointed out that each one gives the maximum degree of control of some specific crop pests only. DDT gives better control of various jassids, brinjal epilachna, army-worm of paddy,

gram caterpillar and cutworms on potato and cruciferous vegetables than of plant lice, white flies, mealy bugs and hairy caterpillars. BHC controls the majority of crop pests which feed from outside. HETP is another new chemical, which has proved to be of great use in the control of plant lice and mealy bugs. Even against hardy scale insects this insecticide is effective. Parathion is a more recently introduced chemical and is now popular with farmers in Madras State. Baiting with Zinc phosphide to control field rats has almost become a regular agricultural operation. Sulphur, as a dust or spray, is recommended for the control of red spiders and mites.

The arsenical poisons are still in use against some insects. Against sap-sucking insects. Fish oil rosin-soap and tobacco decoction are in common use. The former is effective against mealy bugs and hairy caterpillars and the latter against aphids and thrips. Mixing crude oil emulsion with irrigation water is adopted in the control of termites and root aphids attacking *ragi*.

Concentration.—Some information on the concentrations at which the above mentioned pesticides are applied, is presented below.

Pesticide	Concentration used	Trade names, if any
DDT	(*i*) 5% dust ordinarily. In case of cutworms 10% dust may be used.	Guesarol
	(*ii*) One ounce of 50% wettable powder in 3 gallons of water.	Didimac, Hexamar DDT
BHC	5% dust ordinarily. In case of hairy caterpillars, striped bug of paddy, grasshoppers and Gryllids, 10% dust may be applied.	Gammexane, Hexidol, Hexamar BHC, Benexide.
Fish oil rosin soap	One pound in 4 to 6 gallons of water	—
HETP	One ounce in 6¼ gallons of water	—
Parathion	(*i*) One ounce of active ingredient in 25 gallons of water, against caterpillars, bollworms, stem-borer and coccids.	Folidol, Ekatox, Paramar.
	(*ii*) One ounce of active ingredient in 40-50 gallons of water, against aphids, jassids, thrips and mites.	
Zinc phosphide	One part of the chemical mixed with 49 parts of a suitable base like puffed rice cakes fried in oil, etc., with the addition of attractants like onions. It would be advantageous to change the base at frequent intervals.	

Dosage.—Ordinarily, 15 to 20 lbs. of dust or about 60 to 80 gallons of spray fluid would be sufficient to cover an acre. In the case of crops with a dense vegetative growth, 25 lbs. of dust or 100 to 120 gallons of spray fluid may be necessary. Two to three pounds of dust or three to four gallons of spray fluid may be required to treat a medium-sized tree.

Precautions against Organic pesticides

It has to be emphasised that most of the newer insecticides are extremely potent chemicals and should, therefore, be used at the appropriate dosage and concentration. Otherwise, their use may result in more harm than good. The following precautions may, therefore, be taken :

(a) DDT, BHC and Toxaphene should not be used on cucurbits, as these chemicals are phytotoxic.

(*b*) The application of DDT and BHC may, as far as possible, be avoided on fruits, vegetables and tuber crops. These pesticides may impart an off flavour or a musty smell to the produce of such plants. Lindane, a purified form of BHC, can be used in such cases.

(*c*) Indiscriminate application of DDT and Endrin must be avoided as it might give rise to a secondary infestation of plant lice or mites, by exterminating the natural enemies which keep these pests under check in nature.

(*d*) The produce of treated plants, in the case of fruits and vegetables, should be thoroughly washed before consumption. It would be safe to allow an interval of four to six weeks between the date of last application of the chemical and the harvest.

(*e*) Sufficient care should be taken by the operators engaged in spraying or dusting, to avoid contact with the chemicals. They should wash their hands, face, etc., as soon as the work is over and avoid chewing or eating when they are engaged in work. Pesticides should be carefully stored under lock and key, away from food material.

(*f*) Zinc phosphide is a deadly poison and must be kept away from children, domestic pets, etc. Baits which are left over should be collected and safely disposed of. The arsenical poisons are equally dangerous and should be handled with the utmost care.

Some achievements of the Plant Protection organisation

In India, no systematic studies have been conducted to determine the loss caused by insect pests. On a modest estimate, it may safely be put down as 10%. But the loss should be more serious if pests occur in an epidemic form. It is gratifying to note that as a result of the intensive propaganda carried on by the extension staff, the average farmer has begun to realise the advantages of taking up immediate measures of pest control. Special campaigns are conducted annually for the eradication of pests such as the red hairy caterpillar of groundnut crop and jassids and fulgorids infesting paddy crop. Figures relating to the quantities of pesticides distributed through the

Agriculture Department in Madras State together with an estimate of the areas treated and the benefits accrued in the period 1953—58 are furnished in the accompanying Tables. Pesticides are stocked by the department for sale at cost price. They are supplied at concessional rates in areas declared as pest affected by a special order of the District Agricultural Officer. Dusters and sprayers are also being made available on loan to farmers to the extent possible.

Intensive research on some newer pesticides, *viz.*, Aldrin, Dieldrin, Malathion, Gusathion and some systemic poisons, is also in progress with a view to improving the existing methods of pest control. The department has recently embarked on a new venture of issuing weekly pest forecasts for the benefit of farmers, extension workers and others.

TABLE I

Areas treated and Estimated Additional Yields during 1953-1958

Crop	Area treated in acres (nearest hundred)					Total	Additional yield in terms of	
	1953-54	1954-55	1955-56	1956-57	1957-58	1953-58	Tons	Rupees (Lakhs)
1. Paddy	1,55,000	1,23,300	1,79,500	1,58,400	2,00,000	8,16,200	71,100	213·3
2. Millets	13,300	15,500	9,200	14,300	22,000	74,300	6,600	14·5
3. Vegetables	9,700	6,300	9,000	11,300	18,200	54,500	6,000	16·8
4. Fruit trees (Nos.)	24,700	24,800	49,600	50,800	77,200	2,27,100	—	4·54
5. Commercial crops								
(*i*) Chillies	17,500	18,200	20,100	40,000	48,000	1,43,800	—	143·00
(*ii*) Cotton	1,700	3,500	13,100	13,200	24,800	56,300	—	56·30
(*iii*) Groundnut	1,400	1,600	1,800	11,400	20,500	36,700	—	18·4
(*iv*) Coconut (Nos.)	12,500	58,600	80,900	65,300	33,300	2,50,600	—	5·00
6. Miscellaneous crops	6,700	9,300	9,100	10,700	14,300	50,100	—	50·00

TABLE II

Quantities of Pesticides distributed by the Government during 1953—58

Pesticide	Quantity distributed (In tons and Cwts.)					Total	Value in Rs.
	1953-54	1954-55	1955-56	1956-57	1957-58		
BHC	854—14	710—1	998—6	745—14	858—9	4,167—4	20,58,885
DDT	108—14	59—1	79—13	94—11	151—7	493—6	6,93,042
Calcium arsenate	2—15	3—3	7—6	3—6	5—4	21—14	36,960
Zinc phosphide	2—0	12—8	—	2—9	2—4	19—1	1,21,920
HETP	0—5	1—10	1—1	0—10	1—11	4—17	38,315
Folidol (100 cc. tubes)	—	1,759	17,418	43,490	39,975	1,02,642	5,04,892
Endrin (gallons)	—	—	200	—	539	739	50,252

CHEMICAL CONTROL OF *CHILO TUMIDICOSTALIS* IN WEST BENGAL

By

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Chilo tumidicostalis Hmps., a notorious pest of sugarcane, was reported for the first time by the Ramnugger Cane and Sugar Co., Ltd., Plassey in Nadia district in August/September, 1956. The larva riddles through the cane and replaces the tissues with its frass. If the larval population becomes appreciably high, it naturally results in a drastic reduction in the yield and the sugar content of cane. A single larva is sufficient to kill a young plant but under favourable weather conditions the larval population per grown-up cane becomes so high as to destroy it totally.

As a result of an investigation, it was noted that in most cases the infested canes were unfit for crushing, and burning was the only alternative. The highest number of larvae per cane was found to be 142. Where the canes were partially affected the Mill authorities were, however, quickly harvesting the crop just to recover whatever quantity of sugar they could get. Although the infestation did not spread over the entire area, due to the heavy damage in some places, the percentage of sucrose recovery came down from 10.46 in 1955-56 to 8.84 in 1956-57. As the report of the pest infestation was received very late, it was not possible to adopt any preventive measure. However, the Mill authorities were to adopt certain mechanical methods, like (a) destruction of heavily affected canes, (b) removal of egg masses from the leaves and (c) destruction of moths by light trap, a model of which was suggested by the author. In April, 1957 the captured moths were examined by cutting open the abdomen and it was seen that about 76% of them were gravid.

In 1957, the author visited the different farms of the Mill as well as the adjoining fields of the cultivators early in April so that proper preventive measures might be adopted well ahead. At the time of inspection, appreciably high incidences of *Chilo tumidicostalis* (20%) and *Scirpophaga nivella* Fabr. (15%) were noticed. The average height of the crop was 12 inches to 2½ feet only. The Mill authorities continued the measures mentioned above; but the fields of the cultivators remained unattended to. So, it was thought advisable to adopt preventive measures simultaneously in the cultivators' fields as well, lest they should serve as pockets of breeding grounds for the borers.

The Department of Agriculture, West Bengal, with a view to saving the sugar industry in the State from a repetition of the disaster faced by the Semapore Sugar Factory in Purnea (Bihar) on account of this borer, took up the entire plant protection operation in their own hands on an emergency basis. A sum of Rs. 1,07,063 was sanctioned as a special case for the purchase of chemicals, hiring of aeroplane from the Government of India and for other contingent expenses. The Plant Protection staff of the State was deputed to organise and supervise the control operations. Insecticides free of cost and technical advice were given to the Company. As the cultivators of the locality were flood-stricken and as the State Government had to arrange relief in the aforesaid areas, the entire cost of pest control operations in the cultivators' fields had to be borne by the Government.

The ground operations commenced from the 3rd May, and aerial spraying from the 19th May, 1957. They lasted for 26 days, covering an area of 6,192 acres. 312 hand sprayers and 6 power sprayers were used for the ground operations.

For aerial spraying, a temporary runway was prepared with the help of the said Company within their farm area, which facilitated fuelling and charging the plane with the insecticidal solution and helped the progress of the work.

As the effect of chemicals on this particular borer was not very clearly known, in order to have good residual effect, it was decided by the author to use Endrin (19.5% E.C.) in certain cases and BHC (50% W.P.) and DDT (50% W.P.) mixture in equal proportion in others.

Doses

The doses used were as follows :—

For ground spray

Endrin (E.C.)	0·1% (actual)
DDT (W.P.)	0·125% (actual)
BHC (W.P.)	0·125% (actual)

For aerial spray

Endrin (E.C.)	0·5 lb. (actual)	in 2 gallons of water per acre.
DDT (W.P.)	0·5 lb. (actual)	in 2 gallons of water per acre.
BHC (W.P.)	0·5 lb. (actual)	

Regarding aerial spraying, one or two points may be mentioned for its improvement in future. As the pilot officers undertook this operation for the first time, after completion of their training, some difficulties were encountered in the beginning, especially with regard to uniform coverage of the insecticide. On many occasions, the quantity of insecticide discharged per acre was much more than was anticipated.

The settlement of the spray on the crop was not uniform and the coverage of area per trip varied with the height from which the plane operated. All the fields may not have similar facilities for spraying from a particular height. So, the concentration of the insecticidal solution and the coverage of area per trip must be adjusted accordingly. The discharge of insecticidal solution per unit of time at a constant pressure and speed of the plane has also to be determined.

Results

The area treated was vast, being about 40 miles in length and 20 miles in breadth. The estimation of damage was done at the time of harvest in the sprayed fields. The data was recorded on the basis of number of bored canes in different treatments and also in different varieties of cane (Table I).

TABLE I. *Percentages of infestation in different varieties of cane receiving different treatments.*

Variety	Aerial spraying with Endrin (19·5% E.C.)	Hand spraying with Endrin (19·5% (E.C.)	Hand spraying with DDT+BHC (50%W.P.)
Co·543	11·57%	12·72%	19·38%
Co·313	x	x	16·04%
Co·527	x	x	21·05%
Bo·11	x	x	19·18%

On the whole, it is apparent from the Table that Endrin produced the best results. The average incidence of the borers, taking together the fields of the Company and the cultivators' fields where no mechanical control measures were adopted, was 11.57% in case of aerial spraying with Endrin and 12.72% in the case of ground spraying with the same chemical as against 70% to 80% of incidence in 1956. There was also some indication that aerial spraying was slightly better than ground spraying as in the latter case, the population was higher by 1.15%. This was probably due to better coverage by the plane than by hand- and power-sprayers.

The general condition of the crop was found to be much improved, one month after the treatment. This might have been partially due to the phytostimulation effect of the chemicals. The author met many cultivators at different localities, who expressed their satisfaction with the results of the treatment.

The good effect of spraying is evident when the recovery of sucrose is considered.

TABLE II

Year	Recovery	Remarks
1955-56	10·46%	Normal year
1956-57	8·83%	Year of epidemic
1957-58	10·53%	Year of spraying

Recommendations

During the winter season, this pest was noted to hibernate mostly in matured canes and a few in the young plantation in scattered areas. So, the author is of the opinion that in order to avoid severe infestations of this pest, crushing of canes must be completed by the first week of February at the latest and also the removal and destruction of 'dead hearts' must be done in the fields of new plantation. It was revealed by the light trap catches that the activity of the adult moths was the maximum in the first week of March. So, an insecticidal treatment in the last week of February is to be applied for better protection of the crop.

Summary and Economics of Spraying

1. Date of starting control operations (Ground)	3rd May 1957	
2. Date of starting control operations (Aerial)	19th May 1957	
3. Date of termination of operations (Ground)	23th June 1957	
4. Date of termination of operations (Aerial)	29th May 1957	
5. No. of centres from which control operations were carried out.		
(*a*) Ramnugger Mills farm	16	
(*b*) Cultivators' fields	17	
TOTAL ..	33	
6. No. of hand sprayers used	312	
7. No. of power sprayers used	6	
8. No. of aeroplanes used	1	
9. Chemicals used, with cost :		
		Rs.
(*a*) Endrex 20—890 gallons		57,682·71
(*b*) BHC (50%W.P.) 1 ton, 6 cwt., 41 lb.		2,415·17
(c) DDT (50%W.P.) 1 ton. 6 cwt., 2 lb.		6,680·81
TOTAL ..		66,778·69
10. Cost of labour		5,375·06
11. Expenditure on aeroplane		6,630·30
12 . Other, miscellaneous expenditure		600·00
GRAND TOTAL		79,384·05

13. Area covered:

(*a*) By hand-and power-sprayers	4,689·925	acres
(*b*) By aeroplane	1,502·000	acres
TOTAL ..	6,191·925	acres

14. Cost of treatment

	Rs.	
(*a*) Cost per acre (average)	12·6	(including insecticides)
(*b*) Cost per acre (on plane)	4·41	
Cost per acre (on labour)	1·12	
(*c*) Cost of insecticides per acre :		
Endrin	16·50	
BHC 50% W.P.) DDT 50% W.P.)	7·50	

Total area treated	6,192 acres
Total yield in the area in 1956-57	30,34,080 mds. of cane
Total yield in the area in 1957-58	32,81,760 mds. of cane
Extra yield in 1957-58	2,47,680 mds. of cane
Extra yield in terms of sugar	24,768 mds.
Cash value of the extra yield	Rs. 9,90,720 @ Rs. 40/- per md.
Cost of spraying	Rs. 79,384·05
Net savings	Rs. 9,11,335·95
Percentage of extra yield	7·55 (i.e., 7·55 mds. of canes per 100 mds. of canes)

The reduction in yield in 1956-57 was due to borer attack. In some cases, the attack was so heavy that the fields (about 200 acres) had to be burnt for fresh plantations. In 1957-58, a total of 32,81,760 (530 mds. per acre) maunds of cane were obtained from the treated area and the calculation on the economics of spraying has been based on the difference in the yield figures of 1956-57 and 1957-58, irrespective of other factors which might have influenced the yield of 1957-58. But the data collected on the nature of the infestation and percentage of attack shows that this increase in yield was largely due to spraying with insecticides.

Acknowledgements

I should like to convey my sincere thanks to the Government of West Bengal for their generous financial help to carry on these operations, to Dr. H. K. Nandi, Director of Agriculture, West Bengal, for his keen interest in the work and helpful advice from time to time, to Dr. K. B. Lal, Plant Protection Adviser to the Government of India, for the loan of a Beaver aeroplane for aerial spraying and to the Ramnugger Sugar Mill authorities for their active co-operation in the work. Lastly, I should like to thank Shri A. N. Basu, Shri S. K. Ghosh, Shri K. Sen Gupta, Research staff of the Entomology Section who, with the help of Plant Protection staff, spared no pains to make the operations successful.

LARGE-SCALE TREATMENT OF WHEAT SEED AGAINST LOOSE SMUT AND EARCOCKLE DISEASES IN THE PUNJAB DURING 1958

By

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and

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Wheat, which occupies an area of over five million acres in the Punjab State, is subject to a large number of diseases, of which loose smut and earcockle are not only highly destructive, but are also co-extensive with its cultivation. During 1957-58 the damage due to the two diseases ranged from 2 to 30 per cent in different localities. It has been estimated that the financial loss, caused by these, when taken together even at a conservative estimate of 5 per cent damage, easily amounts to Rs. 3 crores annually in the State.

Loose Smut

Loose smut, which is caused by the fungus *Ustilago tritici* (Pers.) Rost, destroys the wheat ears completely, turning them into a black, loose powder consisting of millions of very small spores (seeds) of the fungus. When such black heads come out, the smut powder is blown about by wind and infects the developing grains in healthy ears in the field. The grains, which are internally infected, mature normally and cannot be distinguished from healthy ones. These healthy-looking, but actually infected grains, when sown, give rise to ears containing the black spore masses of the smut fungus, which again are blown about by wind to infect the developing grains in the ears in the neighbourhood. Thus, the disease continues year after year, the extent of its infection depending on the weather conditions at the time of flowering of the crop.

Earcockle

In the Punjab, the earcockle disease goes by such names as *mamni, gegla, dhanak, matwa* and *tandu* and is particularly serious in the districts of Kangra, Rohtak, Gurgaon, Hissar and Karnal, where up to 50 per cent damage has been noticed in some fields.

When the disease appears in young plants, wrinkling, rolling and distortion of the leaves are seen, as a result of which the plants look bushy. If the infection is severe, plants die at this stage.

Later, a bright yellow gummy or slimy substance develops on the stems, leaves and ears. Often, the stem and ears get distorted. Ears covered with a yellow slime do not develop any grain in them. On drying, they form a hard, brittle mass.

Many diseased plants, however, do produce ears, which are greener and remain green longer than the normal ears. In such ears, hard, dark-coloured galls develop in place of normal grains. The galls vary in size, from that of the normal wheat grain to 1/6th of its size. The earcockle galls, as these are called, can be mistaken for weed seeds. In fact, the very name earcockle is due to the fact that these galls resemble the seeds of the cockle weed found in European countries.

Fortunately, the methods of controlling the two diseases are very simple and when properly carried out, eliminate them completely.

Although these methods have been known for over two decades in the Punjab, it is only recently that all-out efforts have been made to popularise them and the success attained has been remarkable.

Control Campaign

During the summer months, May and June, 1958, a combined loose smut and earcockle control campaign was launched, preceded by a fortnight of intensive propaganda and the actual demonstration of the solar treatment to eliminate the former disease and the floatation method to remove the galls of the latter disease. During the process of soaking wheat seed in water for four hours from 8 A.M. to 12 noon, which is the first essential step in carrying out the solar treatment against loose smut, the galls of the earcockle disease were removed with ordinary sieves immediately after the wheat seed was put into water, contained in tubs, buckets and iron pans (*karahas*). The floating hard black galls were removed within the first five minutes. This precaution was necessary, because some of the galls, when allowed to float for a longer period, sink and thus escape removal with a sieve.

The campaign was carried out by the Punjab Agriculture Department in close co-operation with Block Development Officers and Village-Level Workers. The plan of the campaign was that each Village-Level Worker, along with such other members of the staff of the Block as became available, spent two days in each village of his circle of ten villages. He got the actual control operations carried out by the cultivators with the assistance of local *Panchayats* and village leaders, each of whom was assigned a definite number of farming families. Arrangements for the operations were made beforehand on the previous evening, when the nature of the two diseases and the methods of their control were fully explained to the farmers. On the day of the operations, the farmers soaked their seed in the morning at the proper time, *i.e.*, at 8 A.M., taking care that the day was not windy and was bright and cloudless. At 12 noon, the wheat

seed, from which the floating earcockle galls had been removed with sieves, was spread out in the bright hot sun in a thin layer on sheets of cloth or Hessian, ordinary household thick sheets (*khesis*), or any other cloth or on tarpaulins, and was dried completely till sunset. When the seed became cool and dry in the evening, it was put into bags for storage till sowing time during the winter.

Instructions for carrying out the campaign in the non-block areas were also issued to the Revenue staff of the State through Deputy Commissioners. The District Agricultural Officers with the help of the District Extension staff and the Plant Protection Inspectors also carried out the campaign in the non-block areas. The Managers of the Agriculture Department's experimental and seed farms treated the seed to meet their own needs.

The combined loose smut-*cum*-earcockle campaign was terminated in July on account of the rainy season having set in. But since the earcockle galls can be separated by the 'floatation method' at any time before sowing wheat, their separation was recommended in September, after the cessation of rains and was continued through October, November and December, 1958.

The seed was immersed in water as during the months of May and June and immediately agitated with hand to enable the galls to float to the surface, from where they were skimmed with sieves. The seed was not allowed to remain under water for more than 5 minutes. This brief period of immersion did not wet the interior of the grains and even their exposure to the sun for about 1 hour was quite adequate to remove the superficial moisture, yet the seed was kept in the sun till the evening to ensure its being dried completely, if it had to be stored for some time before sowing. In case the seed was to be sown without any delay, such a precaution was not necessary.

Achievements

As the result of the efforts of all the above agencies, loose smut was eliminated from 1,71,831 maunds, and the galls of the earcockle disease were removed from 4,69,238 maunds of wheat seed.

It is estimated that wheat seed freed from loose smut was sown over an area of about 2.5 lakh acres and that freed from earcockle galls over an area of 7 lakh acres. Thus, the Punjab State will have about 10,000 tons of additional grain valued at approximately 50 lakhs rupees. As the annual loss due to these two diseases has been estimated to be not less than 3 crores of rupees in the Punjab State, a long way has to be covered before the farmer can be saved from the ravages of these two great enemies of his. In order to avoid this huge, but easily preventible, loss due to these diseases, similar campaigns will be launched during the years to come, the aim being to control these two diseases completely.

The eradication of loose smut of wheat, which is wind-borne, and, therefore, can be spread from the fields raised from untreated seed to those from treated seed, will need annual efforts for a considerable period of time, but earcockle, once eliminated from the seed, will not appear unless and until the gall-infested seed is sown again. Thus, the produce of about 7 lakh acres sown this year will be free from earcockle galls and can be used to raise earcockle-free crop during subsequent years. The produce of an area of about 2.5 lakh acres will, no doubt, be without loose smut during the next harvest season, but owing to the blossom infection with wind-borne spores from the untreated fields, it will have to be subjected to solar treatment again during the following summer. Thus, the effectiveness of the solar treatment is limited only to one season. Thus it becomes clear that if loose smut is to be kept in check, the wheat seed will have to be treated for the whole area in a single season, so that the source of inoculum for wind-borne blossom infection is also eliminated. This is the aim, though difficult, yet not impossible of attainment. Only the farmers have to be persistently educated to introduce solar treatment of wheat seed into their regular and essential farming practices.

LIST OF INTERCEPTED PLANT PESTS

By

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Some of the interceptions made at the Plant Quarantine Stations, Bombay and Madras, were published in *Plant Protection Bulletin*, Volume VI, No. 4, 1954. Since then no list of intercepted plant pests has been published. Some insect pests, plant pathogens and certain other organisms found in, on or with the plant materials imported at different Plant Quarantine Stations during the period 1955 to 1958 are included in the accompanying list. Quite a large number of interceptions are not included in the list as some could not be identified and the others are being identified, which will be published later. In many cases the specific name could not be determined. Identification of intercepted plant pests usually takes a considerably long time. The identification of most of the plant pathogens included in the list has been made by the officers at the various Plant Quarantine Stations.

The list includes the host, plant pest, country of origin of the host and the place of interception. Every effort has been made to give the correct identification and origin for all the collections listed.

Not in all cases the scientific name of the plant pest is given. In a few, only the broad group to which the plant pest belongs is indicated, as the intercepted material was very limited and not sufficient or suitable for proper identification.

Plant pests intercepted on, in or with imported plant materials during 1955—58

Host	Plant pest	Country of origin	Inspected at
(1)	(2)	(3)	(4)
	1955		
Cladium sp.	*Aspergillus* sp.	U.S.A.	Bombay.
Cocos nucifera	*Alphitobius piceus*	Ceylon	Cochin.
	Corcyra cephalonica	Do.	Do.
Dahlia sp.	*Botrytis* sp.	Netherlands	Bombay.
	Fusarium sp.	Do.	Do.
Garcinia mangostana ..	*Pseudococcus* sp.	Ceylon	Do.

(1)	(2)	(3)	(4)
Gladiolus sp.	*Alphitobius sp.*	Netherlands	Bombay.
	Bacterium marginatum	Do.	Madras.
	Eutrytis gladioli	Do.	Bombay.
	Fusarium sp.	Do.	Do.
	Fusarium oxysporum var. *gladioli*	Australia	Madras.
	Penicillium gladioli	Netherlands	Bombay.
	Septoria gladioli	U.K.	Madras.
Gossypium sp.	*Tribolium* sp.	U.S.A.	Bombay.
Grass cuttings	*Acrothecium* sp.	Ceylon	Do.
	Fusarium sp.	Do.	Do.
Hevea sp.	*Botryodiplodia theobromae*	Malaya	Madras.
	Phomopsis heveae	Do.	Do.
Hyacinthus sp.	Mites	Netherlands	Bombay.
Mentha sp.	Nematode	France	Do.
Orchids	*Rhizoctonia* sp.	U.K.	Do.
Prunus persica	*Botrytis* sp.	U.S.A.	Do.
Rosa sp.	*Botrytis* sp.	U.K.	Do.
	Coniothyrium fuckelii	Ireland, U.S.A.	Madras.
Solanum tuberosum	*Actinomyces scabies*	Scotland	Bombay.
	Corticium solani	West Germany	Do.
	Erwinia cartovora	Netherlands	Do.
	Rhizoctonia solani	Do., Scotland Do.,	Madras.
	Fusarium sp.	Netherlands	Do.
	Spondylocladium atrovirens	Scotland	Madras.
	Spongospora subterranea	Do.	Do.
Tulipa sp.	*Botrytis tulipae*	U.K.	Bombay.
Vitis vinifera	*Alternaria* sp.	U.S.A.	Do.
	Cladosporium sp.	Do.	Do.
Vitis sp.	*Phoma* sp.	Pakistan	Madras.
	1956		
Cashewnut	*Tenebroides mauritanicus*	Africa	Cochin.
	Tribolium castaneum	Do.	Do.
Cocos nucifera	*Botryodiplodia theobromae*	Malaya	Madras.
Garcinia mangostana	*Pestalotia* sp.	Do.	Do.
Gladiolus sp.	*Bacterium marginatum*	U.K., U.S.A.	Do.
	Fusarium gladioli	U.K.	Do.
	Fusarium oxysporum	U.K.	Do.
	Penicillium sp.	U.K.	Do.
Gloxinia sp.	*Thielaviopsis* sp.	U.K.	Do.
Gossypium sp.	*Ascochyta gossypii*	Sudan	Do.
	Tribolium sp.	Do.	Do.
Manihot esculenta	*Botryodiplodia theobromae*	Malaya	Do.
Narcissus pseudonarcissus	*Pencillium* sp.	Canada	Do.
Nicotiana tabacum	*Alternaria* sp.	U.S.A.	Do.
	Cercospora sp.	Do.	Do.
	Lasioderma	Do.	Do.
Prunus persica	*Macrophoma* sp.	China	Do.
	Septoria sp.	Do.	Do.
Rosa sp.	*Coniothyrium* sp.	U.K.	Do.

(1)	(2)	(3)	(4)
Solanum tuberosum ..	*Actinomyces scabies*	Netherlands	Madras.
	Rhizoctonia solani	Do.	Do.
	Spondylocladium atrovirens	Do.	Do.
	Spongospora subterranea	Do.	Do.
Tapioca	*Botryodiplodia theobromae*	Malaya	Do.
	1957		
Begonia sp.	*Botrytis* sp.	Netherlands	Bombay.
	Fusarium sp.	Do.	Do.
Dahlia sp.	*Aspergillus* sp.	U.S.A.	Do.
Gladiolus sp.	*Aspergillus* sp.	Netherlands	Do.
	Botrytis sp.	Do.	Do.
	Fusarium sp.	Do.	Do.
Hevea sp.	*Botryodiplodia theobromae*	Malaya	Madras.
	Phomopsis heveae	Do.	Do.
Nicotiana tabacum ..	*Cercospora nicotianae*	Netherlands	Do.
	Lasioderma serricorne	Do.	Do.
	Oryzaephilus surinamensis	U.S.A., Japan	Bombay, Madras.
	Tribolium castaneum	Japan	Madras.
Ranunculus sp. ..	*Aspergillus* sp.	Netherlands	Bombay.
Rosa sp.	*Fusarium* sp.	Saudi Arabia	Do.
Solanum tuberosum ..	*Actinomyces scabies*	Scotland	Madras.
	Rhizoctonia solani	Do.	Do.
Tulipa sp.	*Botrytis* sp.	Netherlands	Bombay.
	1958		
Alectryon sp. ..	*Rhabdospora* sp.	Malaya	Madras.
Areca catechu	*Araecerus fasciculatus*	Do.	Do.
	Colletotrichum sp.	Fiji Islands, Malaya.	Do.
	Coniothyrium sp.	Do.	Do.
	Fusarium sp.	Do.	Do.
	Laemophloeus sp.	Do.	Do.
	Lasioderma serricorne	Do.	Do.
	Oryzaephilus surinamensis	Do.	Do.
	Penicillium sp.	Do.	Do.
	Tribolium castaneum	Do.	Do.
Beta vulgaris	*Alternaria* sp.	France	Do.
	Cercospora sp.	Do.	Do.
	Fusarium sp.	Do.	Do.
	Uromyces sp.	Do.	Do.
Chrysanthemum sp. ..	*Puccinia* sp.	Japan	Calcutta.
	Trichoseptoria sp.	U.K.	Do.
	Virus (Spotted wilt)	Do.	Do.
Cocos nucifera	*Botryodiplodia theobromae*	Malaya	Madras.
Dahlia sp. ..	*Sclerotinia* sp.	Netherlands	New Delhi.
Hevea sp.	*Botryodiplodia theobromae*	Malaya	Madras.
	Phomopsis heveae	Do.	Do.
Ipomaea batatas	*Penicillium* sp.	Spain	New Delhi.
Mangifera indica	*Colletotrichum* sp.	Indonesia	Madras.
Musa paradiasica ..	Psocids	Philippines	Do.
Narcissus pseudonarcissus	*Botrytis narcissicola*	U.K.	Do.

(1)	(2)	(3)	(4)
Nicotiana tabacum ..	*Alternaria* sp.	U.S.A.	Madras
	Cercospora sp.	U.S.A., Cuba	Do.
	Lasioderma serricorne	Cuba, U.K., Netherlands, Belgium	Do.
	Oryzaephilus sp.	Belgium	Do.
	Tribolium sp.	Do.	Do.
Pinus markasii	*Fusarium* sp.	Burma	Do.
Piper nigrum	*Pseudococcus* sp.	Sarawak	Do.
Rosa sp.	*Coniothyrium fuckelii*	Ireland, England	Do.
	Fusarium sp.	West Germany	New Delhi
	Pestalotia sp.	U.K.	Madras.
Solanum tuberosum ..	*Fusarium* sp.	Czechoslovakia	New Delhi.
Vitex tricolor	*Diplodia* sp.	Ceylon	Madras.
Vitis vinifera	*Penicillium* sp.	Afghanistan	New Delhi.
	Mites	Australia	Madras.
Zinnia elegans	*Alternaria zinnae*	U.K.	Do.

POT METHOD OF TRAPPING FIELD RATS IN MADRAS STATE

By

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Field rat is a pest attacking paddy and other crops in Madras State. In Tanjore district alone, where paddy is cultivated in about 13 lakhs acres, it may be said to cause a loss of about 50,000 tons of paddy every year (5% of standard yield of 1,750 lbs. per acre is taken as loss per acre), assuming that no control measures are taken. However, the pest is kept under check by poison baiting with Zinc phosphide and by mechanical trapping.

Baiting with Zinc phosphide has become popular in recent years. Considerable area under paddy is treated by this method along with the indigenous methods of pot trapping and bow trapping. Pot trapping, which is popular in Tiruchirapalli district, is described in the following paragraphs.

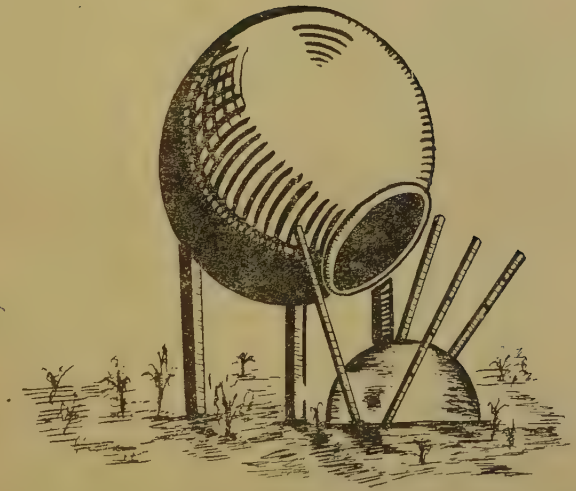
Pot Trap

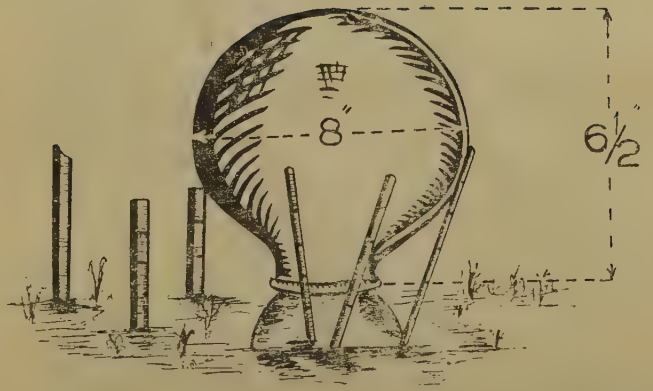
The trap consists of a round earthen pot of 8″ diameter and 6½″ height with a cup-shaped lid and 7 wooden pegs, each of one foot length. The pot is balanced in an inverted position at a height of 3″ from the ground level over a tripod of 3 pegs, one of which is slightly raised as shown in the accompanying figure. The lid is so placed on the ground that the pot falls exactly on the lid when disturbed. The lid is kept in position by driving the remaining four pegs round it so that the pot is not moved from its position by the struggling, trapped rat. Because of the wet condition of the soil, the cup-shaped lid is firmly fixed to the ground, supported by the pegs all round. The bait is usually puffed rice or coconut kernel scrappings. A small quantity of the bait is placed on the lid and some inside the pot. The rat after eating the bait on the lid tries to eat the bait inside the pot which, on being disturbed, falls on the lid and traps the rat.

Setting the Trap

The traps are usually set in the evenings, along the tracts frequented by rats. Generally, rats start attacking the crop from the centre of the field and extend their activities to the periphery. The fields are divided into convenient strips. A small path way to the trap is made by pushing the plants away on either side. This will facilitate easy movement and spotting of the traps subsequently. The traps are allowed to continue in the same places till the catches are regular.

POT TRAP





When it is known that the rats are not attracted any longer in one place, the trap will have to be set in a different place with a change of bait also. This will bring a fresh wave of catches. Normally 20—25 pot traps are distributed in an acre.

The catches are collected by two men in the morning, one of them carrying a gunny bag. The pot is lifted with the lid intact and the rat is let into the gunny bag carefully by inserting the pot fairly deep into the bag so as to prevent the rat from escaping. Immediately after the rat is let in, the mouth of the bag is closed and the rat is either crushed by a club or by beating the bag with the rat against the bund or any hard surface. These killed rats are utilised for food by some people. Thus the dead rats are used, unlike in the case of poison baiting. This method is easy to operate and fairly large catches are obtained. The trap will work more effectively if the pot and lid are washed daily and set up. The pot with lid and pegs costs only about 25 naye paise and will easily serve for a year.

TOXICITY OF PESTICIDE RESIDUES*

A great range of organic synthetic pesticides has come into general use during the last decade. They are characterized by extremely high potency and specific toxicity to pests normally linked with high mammalian toxicity. Thus their widespread adoption as a normal agricultural practice has stressed the need for the utmost caution in avoiding harmful residues on or in harvested products or on pastures. As a result, many governments have enacted legislation to regulate the marketing and use of pesticides for the purpose of preventing hazards, without, at the same time, hindering progress in pest control. In many countries, pesticides must be registered and certified before they are marketed, and must be properly labelled and packed in accordance with regulations. Growers are urged to follow the recommendations given by manufacturers and governmental agents for the safe use of pesticides, especially with regard to the rate and time of application, but such requirements are not enforceable by law because of the many variable factors involved.

A further step in this direction was taken by the governments of the United States and Canada in establishing legal tolerance limits of pesticides on or in various plant products. The main difference between the U.S. and Canadian legislation is that the former covers "raw agricultural products" including forage crops and other animal feeds, whereas the latter is limited to food offered for sale for consumption by human beings.

In Europe, this American venture is being watched with great interest, but except in isolated cases, for instance in the use of parathion for olive fly control, no attempt has been made to establish residue tolerances in a general way. The Sub-Committee of Experts of the Western European Union, at its meeting in Brussels in 1955, suggested maximum tolerable concentrations of residues of some principal pesticides, which in a few cases differed from the levels established in North America. The residue problem was also discussed in late 1957 at a symposium sponsored by the Pesticides Group of the Society of Chemical Industry (United Kingdom), in collaboration with the Association of British Insecticide Manufacturers.

While the need for enforceable legal measures to prevent negligent or ignorant growers from producing food or animal feed containing harmful pesticide residues is well recognized, opinions vary with regard to what extent such requirements should or could be imposed. It has been pointed out that there was no proven case of poisoning of man due to pesticide residues on foodstuff, and that the toxicity of a pesticide to warm-blooded animals may not be necessarily linked with food hazard. There are also many problems in the application

*Reproduced from *FAO Plant Protection Bulletin* Vol. VII, No. 2, November 1958.

and enforcement of such legislation at the extension level. Furthermore, as pesticides are commodities much involved in international trade, manufacturers, encountering a host of regulations and restrictions which vary in different countries, are increasingly apprehensive of the difficulties of developing and introducing new products to the market.

At the recommendation of the European Agricultural Commission and other technical meetings, FAO has been gathering information on legislation in force. It is also proposing to convene a small panel of experts to study various problems relating to the legislative control of the marketing and use of pesticides, especially the establishment of tolerance levels of residues, and to set forth recommendations for reference of interested governments.

PESTICIDE LEGISLATION IN THE UNITED STATES

By

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Within the last ten years there has been tremendous progress in the development of pest control measures. With it has come an increased interest in and recognition of the need for adequate legislation to prevent unfair and deceptive practices in pesticide usage. In the United States this is sought to be achieved mainly by the Federal Insecticide, Fungicide and Rodenticide Act of 1947 and the Federal Food, Drug and Cosmetic Act of 1938. There are various State laws providing additional coverage.

The purpose of this paper is to record some important points of the Federal Insecticide, Fungicide and Rodenticide Act of 1947.

The Federal Insecticide, Fungicide and Rodenticide Act

Federal regulation of insecticides and fungicides in the United States began under the Insecticide Act of 1910. The purpose of this Act, which regulated only insecticides and fungicides, was to prevent misbranding and adulteration of commercial preparations in inter-state commerce.

After 37 years of operation, the original Act was replaced by the present Federal Insecticide, Fungicide and Rodenticide Act of 1947. This legislation became effective for devices* on June 25, 1947; for rodenticides and herbicides on December 25, 1947 and for insecticides and fungicides on June 25, 1948. The basic requirements are essentially the same as under the Act of 1910 but the new Act has been broadened to include rodenticides and herbicides. The old Act did not control marketing of products as effectively as does the new Act.

The first requirement under the Act of 1947 is that every pesticide sold or offered for sale in the U.S. must be registered with the U.S.D.A. (United States Department of Agriculture), prior to introduction in interstate commerce. Data that must be submitted to the Department include the net contents, ingredient declaration, all claims made for it including use directions, the formula of the substance

*Products intended for trapping, repelling, destroying or mitigating insects or rodents and those for repelling, destroying or mitigating fungi, are also covered by this Act.—Ed.

and the description of the tests made upon which the claims are based. In addition, the label must show the name and address of the manufacturer or person for whom manufactured, the brand name, the prescribed poison markings with antidotes in case of the more toxic materials. The product is closely scrutinised by the Department and if found to comply with the requirements of the Act the product is registered. If the product fails to meet the requirements of the Act, the product is denied registration. However, if the applicant insists, in writing, that the product be registered, the Act requires that it be done under protest. The court then acts as the arbiter.*

Pest control products can be transported in inter-state commerce without legal restrictions if intended solely for experimental purpose under an experimental permit from the Department. The label for a pest control product intended for experimental use must, in addition to other statements already mentioned, state that the product is for experimental use only. The application for an experimental permit must show: The name and address of the applicant and the place(s) from which the shipment(s) will be made, the proposed date of shipment, the identity of the product, the approximate quantity of the product to be shipped and the types of tests that will be made.

The Act also requires that a pest control product subject to it, be seized if it is found to be adulterated or misbranded, if it fails to bear on its label the required information or if it is a white powder that is not coloured as required by the Act.

The enforcement of the Act is performed by the Plant Pest Control Branch, Agriculture Research Service, U.S.D.A. Department officials investigate shipments and collect samples, which are sent to the Department's laboratory for chemical analysis. Those found guilty of marketing products differing from that represented in connection with the registration, upon conviction, may be fined upto $1,000. A person guilty of violating other provisions of the law may be fined upto $500 for the first offence while for each subsequent offence the penalty may be upto $1,000 or imprisonment for not more that 1 year or both.

Pest control products imported into the United States are subject to the same requirements.

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*As higher penalties are imposed under the law if a person or firm is found guilty by the court of marketing a misbranded or adulterated product registered under protest, requests for this type of registration have been few.—Ed.

PEST AND DISEASE OUTBREAKS

Procedure for collecting information and maintaining records

1. Pest and disease outbreaks may be considered to have occurred if large crop areas, over about 500 acres or so, in the same locality or in different localities, are so heavily infested with a pest or disease that a reduction in yield to the extent of at least 10 per cent may be easily expected, if measures of control are not undertaken.

2. Irrespective of whether the infestation can or cannot be or has or has not been controlled, it is of the utmost importance to record the infestation at least for future guidance, if not for immediate use. Likewise, the duration of the infestation should not be a reason for not recording it. For example, a crop may be wiped off in the course of a day by locusts or it may continue to suffer damage for days and weeks by some other pest. All the same, economic damage has occurred and should be recorded.

3. It is possible that a light infestation has appeared on some crop and been effectively controlled in the initial stage and the crop has not suffered any appreciable damage. Or, the initial infestation has been removed due to some natural factors, such as, heavy rainfall or many days of high temperature and the crop has been saved the incidence of damage. In such cases, the infestation need not be recorded.

4. Sometimes the same crop may be attacked by more than one pest or disease or both at the same time and the cumulative effect may appreciably reduce the yield or deteriorate the quality of the produce or do both. In such cases, the pest or disease with the highest incidence and the greatest capacity for damage should be recorded as the major cause for the infestation and the other pests or diseases should be recorded as associated agents (*vide* sub-para X following).

5. In recording pest or disease infestations, information on the following points should be clearly obtained and given :—

(*i*) Crop

The common English or botanical name or both should be given. Local names which are not likely to be understood all over India should be avoided. It is not necessary to give the botanical names of such well-known crops as wheat, paddy, sugarcane or such fruit trees as mango, apple, etc.

For convenience of reference, the term 'infestation' is used here in a broad sense and includes attacks by diseases, for which the appropriate term would be 'infection'.

(*ii*) Stage of Crop Affected

Some indication of the stage of the crop immediately preceding the infestation should be given. This can be given either in terms of the age of the crop in days after sowing or the stage of the crop such as seedling, tillering, boot, flowering.

(*iii*) Any Variety of the same Crop in the same Locality not Affected

In an infested area, it is possible that some improved varieties, which may be resistant to pests and diseases, may remain unaffected. The names of such varieties may be indicated.

(*iv*) Locality

Names of villages/*tehsils* or taluks and districts should be given.

(*v*) Area

Area should be given in acres of the infested crop. If the total area of the crop, both infested and uninfested, can also be given, it should be helpful. If the infested crop is spread out in different localities, the area should be given locality-wise. If this cannot be done, at least an estimate of the total area should be given. The areas to be given would, of course, be rough estimates.

(*vi*) Pest or Disease

In as many cases as possible, the scientific name of the pest or disease and the particular stage or stages of the pest causing damage should be given. If the specific name of the pest or the disease cannot be given, at least the genus or the family should be mentioned. Here also, scientific names may not be given in the case of such well-known pests and diseases as locusts, field rats, pink bollworm of cotton, red rot disease of sugarcane, late blight of potato, etc. In the case of pests, it should be stated clearly as to whether the damage has been caused by larvae or adults or both.

(*vii*) Duration of Infestation

Duration should not be expressed in terms of period only, such as five days, three weeks, two months, etc., but approximate dates and months should be given. If a serious and heavy infestation has been controlled by any measure such as spraying or dusting with pesticides, the duration should be reckoned from the time the infestation assumed serious proportions to the time it disappeared as a result of the control measures undertaken.

(*viii*) Climate and Weather

Some indication of the climate and weather, including rainfall, immediately preceding the infestation and during its course, should be given.

(*ix*) Degree of Infestation

Although very light infestations, which are not likely to cause any appreciable damage, need not be recorded, even a properly considered infestation may show different degrees of the intensity of attack by a pest or disease. In such cases the terms mild, moderate, heavy and very heavy should be used. These terms should not be used with reference to the area but should denote the intensity of attack on the crop. For example, an infestation may be wide-spread but it may only be mild or it may be mild in some places and moderate or heavy or very heavy in others. A very heavy infestation, if allowed to go unchecked, should mean that the crop would hardly yield anything. A heavy infestation should be one that may reduce the crop yield by about 50 per cent and more. Moderate and mild infestations should reduce crop yields by about 25 per cent and 10 per cent and more, respectively. In addition, an estimate of the reduction in crop yield feared should be given.

(*x*) Associated Pests and Diseases

Under this heading the names of pests and/or diseases, which may not be responsible for the infestation as such but may be present in appreciable number or to an appreciable extent, should be given and the names should be in accordance with the suggestions made in para 5(vi).

(*xi*) Originally Anticipated Crop Yield

An estimate of the crop yield in terms of maunds per acre or per tree, as originally expected if there had been no pest or disease attack, should be given. This estimate is best made by a Government official in consultation with the farmers concerned. The estimate would, of course, vary from locality to locality and even within short distances of the crop in the same locality but a reasonable average for each locality should be struck and recorded.

(*xii*) Associated Factors

Under this heading any relevant information may be given. For example, if control operations have been successfully undertaken and as a result the infestation has been removed, the fact with some details should be recorded. Likewise, if natural causes have removed or helped the infestation, the fact should be recorded.

(*xiii*) History of Infestation

Under this heading it should be recorded as to whether the infestation is the first of its kind or had occurred in the previous year or season also. Or, the infestation may be periodical as in the case of the mango hoppers or it may be a regular feature year after year. Such information should be recorded.

(*xiv*) SOURCE FROM WHICH SEED WAS OBTAINED

For many plant diseases, which are seed-borne, the history of infection can be traced to the source from which the seed was obtained. In reporting outbreaks of diseases and pests, therefore, an indication should also be given of the source from which the seed was obtained.

(*xv*) CROP OWNERS

The approximate number of farmers or fruit growers, affected by any pest or disease infestation, should be recorded wherever possible. Any important or relevant information or suggestion advanced by them relating to the incidence of the infestation, as distinct from requests for free supply of pesticides or other forms of government assistance, etc., should also be recorded.

(*xvi*) GENERAL REMARKS

Anything relevant, not covered by the previous headings.

6. It is possible that the same pest or disease may be infesting not one but several crops in the same or different localities. If so, the different crops should be treated as distinct and different units and information should be recorded in respect of them on separate sheets. It is suggested that a proforma should be drawn up and the information in respect of different crops should be prepared. If there are several and variable factors affecting the same infestation on the same crop but in different localities, different sheets for each locality should be used.

7. The records of information from different localities and districts in a State should be deposited ultimately with the State Entomologist in respect of pests and the State Plant Pathologist in respect of diseases or with the Plant Protection Officer as the State Government may consider fit. These records may periodically be prepared by the concerned State officers in a form suitable for publication in the appropriate agricultural publications of the State Government or in the *Plant Protection Bulletin* of the Directorate of Plant Protection, Quarantine and Storage. The outline of a proforma for recording information is presented herewith.

Record of Pest/Disease Outbreak

Name of State :

1. Crop affected
2. Stage of crop affected
3. Any variety of the same crop in the same locality not affected
4. Locality
5. Area involved
6. Pest/disease
7. Duration of infestation
8. Climate and weather
9. Degree of infestation
10. Associated pests/diseases
11. Originally anticipated crop yield
12. Associated factors
13. History of infestation
14. Source from which seed was obtained
15. Crop owners
16. General Remarks

Information initially collected by :

Information verified by :

Place :

Date :

MAJOR ACTIVITIES OF THE DIRECTORATE OF PLANT PROTECTION, QUARANTINE AND STORAGE DURING 1958

Central Plant Protection Stations

The fourteen Central Plant Protection Stations at Amravati, Bara Banki, Bilaspur, Cuttack, Dharwar, Ernakulam, Gauhati, Gaya, Hyderabad, Indore, New Delhi, Palanpur, Pathankot and Tiruchirapalli, whose establishment had been completed in 1957, continued to function and assist the State Governments and others in controlling outbreaks of pests and diseases. Eight Stations carried out intensive plant protection work, each in a selected village of a *Gram Panchayat*. About 420 tons of different pesticides were supplied to various parties, including some Government departments and other organizations. Likewise, 5,197 power— and manually—operated spraying, dusting and seed-treating machines were loaned for a total period of 95,046 machine days to various parties in different States. Short training programmes in plant protection were organized by the Stations for some agricultural and extension staff of the States and some Vigyan Mandir officers, and 685 such officials were trained. In addition, training was also imparted to 1,061 extension workers of other categories (Village Leaders, *Gram Sevaks*, etc.) and to 410 cultivators.

Aerial Unit

An Aerial Unit consisting of 2 Beaver and one Auster Autocar aeroplanes sprayed and dusted 22,135 acres under paddy crop in Assam and Uttar Pradesh, cotton crop in the Punjab, sugarcane crop in Bihar and Bombay States and *jowar* crop in Bombay State, against different pests, bringing the total area treated from the air to 41,294 acres since May 1957, when the Unit started functioning. Notable developments in the aerial operations were, a large scale dusting of paddy crop with 10% BHC dust @ 4 to 5 lbs. per acre from the air in Uttar Pradesh, large-scale top dressing and hormone spraying on sugarcane crop in Bihar and spraying with BHC wettable powder in concentrated form on rice crop in Assam.

Plant Quarantine

Plant Quarantine Stations continued to function at the seaports of Bombay, Calcutta, Cochin, Madras and Visakhapatnam and at the airports of Amritsar, Bombay, Calcutta, Madras and New Delhi. Cotton bales imported from America or the West Indies were, as before, compulsorily fumigated at the seaports of Bombay, Cochin and Madras. Of the total number of 97,703 cotton bales imported, 79,118 bales were fumigated at Bombay, 10,870 bales at Cochin and 7,715 bales at Madras. In addition, 451 cotton samples, not exceeding 20 lbs. in weight each, received by sea or air, were also fumigated at Bombay.

The following are the consolidated figures of the various commodities, imported by sea and by air, which were inspected and treated at the various Stations :—

SEAPORTS

Bombay — 434 nursery plants and cuttings, 6,919 lbs. of seed potato, 20,868 ornamental bulbs and tubers, 3,80,066 lbs. of unmanufactured tobacco and 1 lb. and 2 oz. of cotton seed.

Calcutta — 4 consignments and 690 nursery plants and cuttings, 2 consignments and 56,377 bulbs and tubers and 1 consignment of miscellaneous seeds.

Cochin — 24 bags of coffee seed and 2 bags of coconut.

Madras — 1 consignment and 113 nursery plants and cuttings, 44 lbs. of seed potato, 95 ornamental bulbs and tubers, 12 mangosteen fruits, 58,738.5 lbs. of unmanufactured tobacco, 6,720 lbs. of cured cocoa bean, 3,46,630 rubber seeds, 165 bags of cumin seed, 17,250 lbs. of betelnut and 23 lbs. of miscellaneous seeds.

The stores of 76 foreign ships were inspected at the Visakhapatnam seaport for the presence of exotic insect and other pests, and diseases.

AIRPORTS

Amritsar — 365 nursery plants, 7,489 lbs. of fresh and dry fruits and 167 lbs. of vegetables.

Bombay — 3 consignments and 527 nursery plants, cuttings and cutflowers, 19 lbs. of ornamental bulbs and tubers, 236 consignments of fruits, 42 consignments and 25 lbs. of unmanufactured tobacco and 2 consignments, 179 packets and 10 lbs. of miscellaneous seeds.

Baggage inspection of 62 foreign aircraft was attended.

Calcutta — 2 consignments, 15 bunches and 1,386 nursery plants, cuttings and cutflowers, 44 ornamental bulbs and tubers, 18 baskets, 1 bag and 406 miscellaneous fresh fruits and 1,300 cactus seeds.

Baggage inspection of 849 foreign aircraft was attended.

Madras — 538 nursery plants, cuttings and cutflowers, 12 ornamental bulbs and tubers, 18 lbs. of unmanufactured tobacco, 2,10,020 rubber seeds, 140 arecanut seeds, 38 clove seeds, 166 lbs. of miscellaneous seeds and 1 consignment of cotton seed.

New Delhi 10 lbs., 15 bundles and 5,350 nursery plants, cuttings and cutflowers, 557 lbs. of potato and sweet potato tubers, 891 ornamental tubers and bulbs and 166 lbs. and 6 lbs. fresh and dry fruits, respectively.

The following plants and plant materials meant for export to foreign countries were examined, treated and phytosanitary certificates issued at the various Stations :—

Bombay One consignment of 'Doob' grass, 60,368 lbs. of *Costas* roots, 2,807 plants and cuttings, 3,254 lbs. of onion seed and 2 consignments of ginned cotton.

Calcutta 47 consignments and 3,574 nursery plants, cuttings and cutflowers and 1,500 ornamental bulbs and tubers.

Madras 1 consignment of cutflowers, 82,400 lbs. of turmeric and 10,000 lbs. of onion seed.

New Delhi 44 nursery plants and cuttings and 1 packet and 29 lbs. of miscellaneous seeds.

Visakhapatnam 5,76,292 lbs. of unmanufactured tobacco, 10,976 lbs. of annato seed and 1,81,440 lbs. of groundnut cake.

In view of the appearance of wart disease of potato in certain areas of Darjeeling district of West Bengal, a survey of potato crop in three police *thanas* in the Darjeeling sub-division, covering about 2,300 acres, was conducted by the Plant Quarantine Station at Calcutta, in collaboration with the Plant Pathologist of the West Bengal Government. The survey revealed wart disease infections or incidences in all the localities.

Locust Survey, Intelligence, Investigations & Control

The Locust Warning Organization continued to function as before and various desert areas in Rajasthan, Punjab and Bombay State were regularly surveyed for locust adults and hoppers. Reports were prepared, examined and consolidated at the headquarters of the Directorate at New Delhi and fortnightly bulletins on the locust situation in India and other countries were issued throughout the year.

Of the 144 vehicles of various descriptions, available in the Locust Warning Organization and scattered at its 28 locust outposts including 8 zonal and 3 circle headquarters, approximately 91 were road-worthy at the end of the year. Others were under repair or overhaul. Likewise, 162 power dusters, 85 power sprayers, 6,135 hand dusters and 68 hand sprayers were available, several hundreds of which had to be diverted to one or the other of the Central Plant Protection Stations for assistance in the control of pests other than

locusts. Of about 1,241 tons of BHC dust and other insecticides, approximately 490 tons were sent out to one or the other of the Central Plant Protection Stations for supply to State Governments.

The Field Station for Investigations on Locusts at Bikaner continued to function. Several field trials were laid out and the work proceeded according to the previously laid out programme, which was, however, revised towards the end of the year in view of fresh information and experience gained.

DERATTING OF AIRCRAFT

A trial fumigation for deratting an aircraft was successfully carried out at the Santa Cruz airport, Bombay, on 28th February, 1957, by the Directorate of Plant Protection, Quarantine & Storage, in collaboration with the Directorate General of Civil Aviation and the Directorate General of Health Services.

A Constellation plane was made available for the purpose by the Air India International. The Airport Medical Officer and a representative of Air India International were present during the trial.

The aircraft was parked a little away from the hangars, and a guard was posted to prevent any unauthorised persons coming near the aircraft.

The cubic capacity of the aircraft was calculated to be as under :—

	cu. ft.
Cockpit	230
Navigators cabin	290
Galley	500
Passenger cabin	3,750
First toilet	420
Second toilet	420
Forward baggage compartment	150
Rear baggage compartment	160
TOTAL	5,920

A proprietary material known as Zyklon was employed for fumigation. It consists of discs of absorbent paperpulp or similar substance impregnated with liquid hydrocyanic acid, which, on exposure to air, evolves hydrocyanic acid gas. This material is available in different packings, the smallest containing 40 oz. of liquid hydrocyanic acid. Along with the tin containing Zyklon discs, a gadget for quick opening of the tin is also provided. The operator should wear a gas-mask and then open the tin, taking care to see that the canister of the gas mask is not directly above the tin, as concentrated fumes emanate on opening the tin and the canister will not filter such heavy concentration of the gas. The discs should be handled with rubber gloves, as otherwise swelling of the hands will result.

The aircraft was first examined and the various ducts etc., were closed. All communicating doors were kept open. The cockpit exit door was closed and the aircraft was cleared of all persons. The main cabin door was kept open and the step ladder was placed ready in position for the operator to make a quick exit after completing the operation.

Some cages containing live rats were placed for observation in the following compartments :—

One each in the cockpit, navigators cabin, galley, fore cabin, rear cabin, toilets, forward luggage hold and rear luggage hold.

The tin containing Zyklon was opened in one of the toilets and after placing the required number of discs in the W.C. a quick exit was made into the main cabin and the toilet door was closed. This operation was repeated in the second toilet. Next, the discs were distributed in the following order, namely, cockpit, navigators cabin, galley, forward and rear cabins. The discs were placed on pieces of paper which had been spread on the floor previously. The operator wore a gas-mask throughout. As the application of the fumigant had to be carried out as expeditiously as possible, the whole operation had to be carefully pre-planned in such a manner that the operator did not make any unnecessary movement or delay and was always backing out towards the exit. After the last disc was distributed, the exit door was closed from the outside, by the operator.

Within half an hour after the application of the fumigant the rats in the cockpit and cabin, which could be observed through the windows, had collapsed. Another half an hour was allowed in order to let the gas penetrate effectively into luggage holds etc., before commencing decontamination of the aircraft.

The decontamination of the aircraft was carried out by using a ground air-conditioning plant. This was connected to the main inlet duct and the blower started. The exit doors of the cockpit and the passenger cabin were opened. After about 10 minutes, the ducts in the roof of the cabin were also opened by the operator. After another ten minutes the air-conditioner hose was disconnected and air was directly blown in for a few minutes; first into the luggage holds, then into the cabins through the front and rear doors. The toilet doors were next opened and the hose turned into them for a few minutes. The gas mask was worn while entering the aircraft to open the doors, ducts, etc.

After ascertaining by the use of methyl orange test papers that the interior of the aircraft was free of hydrocyanic acid gas, the doors of the lockers, drawers etc., were opened and every nook and corner of the aircraft was tested for the presence of any traces of the gas.

It was found that complete decontamination had been achieved in less than 40 minutes or within two hours from the commencement of the operation. The aircraft was then kept under guard for another two hours as a further precaution, before pronouncing it as safe for entry.

No dosage of the gas was applied to the luggage compartments. The gas from the cabin was found to have penetrated through the floor boards in sufficient concentration to kill the rats placed there.

The Zyklon discs were distributed in the following manner :

	discs
Cockpit	2
Navigators cabin	2
Galley	3
Fore and rear cabins	12
First toilet	2½
Second toilet	2½

The fumigant applied works out to about 4 ozs. of hydrocyanic acid gas per 1,000 cu. ft. of space.

Conclusions

It was found that aircraft could be fumigated for deratting, effectively and cleanly by the use of Zyklon.

Decontamination of the aircraft could speedily and effectively be carried out by employing the ground airconditioning plant.

A REVIEW OF THE USE OF CROP PROTECTION CHEMICALS IN SOME FOREIGN COUNTRIES*

Australia

Chemicals are widely used in Australia for the control of pests and diseases and in 1955-56 the value of the insecticides and vermin spray materials amounted to $15 million. They are used over a wide range of crops and for livestock. In vineyards, orchards and vegetable plantings there is commonly a regular spray programme with the fairly rapid adoption of new materials where these are shown to give greater protection.

With field crops there are a number of examples where chemicals are contributing to successful production. With sugarcane the use of BHC has greatly improved the control of the cane grub, while with cotton and tobacco there are regular spraying programmes with dieldrin and aldrin replacing DDT to an increasing extent.

More use is now being made of weedicides. Over two million acres of cereals are being sprayed for weed control annually; extensive areas of scrub have been sprayed in the course of land development in Queensland and more effective control of some serious noxious weeds is now being achieved.

Japan

Approximately two thousand kinds of agricultural chemicals (insecticides, fungicides, herbicides, rodenticides and the like) are registered with the Ministry of Agriculture and Forestry in Japan. Among those applied to rice production, for example, are mercury, copper and copper mercury fungicides for controlling diseases, mineral oils, lead arsenate, calcium arsenate, pyrethrum, derris, nicotine, DDT, BHC, TEPP, EPN, parathion, and methyl parathion for controlling insects, 2,4-D and MCP for killing weeds, and chloropicrin and methyl bromide as grain fumigants. The total value of agricultural chemicals used from October, 1956 through September, 1957 is estimated at 20 billion *yen* (360 *yen* = 1 dollar).

Agricultural chemicals have long been used in Japan to control insects and diseases of fruits and vegetables. New chemicals have come to be applied on a large scale also to rice, wheat, barley, soybeans, sugarcane, rapeseed, potatoes, mulberry, tea and flowers.

Introduction of new chemicals, together with improved applicators, has very efficiently controlled insects and diseases which had been among the main causes of unstable farm production in the past. Reduction in losses per year by use of pesticides would be about 100 billion

*Information extracted from the *National Agricultural Chemicals Association News and Pesticide Review*, Washington, D.C., Vol. 16, No. 4, August 1958.

yen in rice, and 25 billion *yen* in fruits and vegetables respectively. Popular use of 2, 4—D has decreased to a great extent the labour required to kill weeds.

Production of pesticides has increased rapidly since World War II. During the period from October, 1956 through September, 1957 it was as follows :

Form	*Quantity* (Metric tons)	*Value* (1,000 *yen*)
Dust	122,984	7,072,157
Wettable powder	13,443	3,294,757
Solution & emulsion	29,902	6,502,014
Others	4,335	502,447
	170,664	17,371,375

Some chemicals are imported, mostly from the United States, some from West Germany, United Kingdom and Switzerland. The total amount imported during the above one year period was approximately 3,870 thousand dollars (CIF), or 8 per cent of domestic production.

U.S.S.R.

In the USSR, chemicals play a decisive part in protecting agricultural plants against pests and diseases. This does not exclude other means of protection of plants, in particular, the biological method in which a number of cases yield a still better effect.

In 1957, approximately 390,000 tons of different preparations were used in the USSR to combat agricultural pests and diseases, as against 53,000 tons in 1940. A considerable amount of the chemicals used in agriculture are manufactured in the form of finely-dispersed powders, used to spray the crops and plantations.

This is determined by the huge amount of work carried out by the State in the struggle against such pests as locusts, the wheat bug and the wheat cutworm, where the most efficient results are obtained from the use of DDT and Hexachlorcyclohexane dust.

For industrial crops, preparations requiring a lesser expenditure of liquids are being more and more widely used in recent years. In particular, in order to protect the cotton plants against the red spider and a number of sucking insects, mercaptophos and other phosphororganic poison-chemicals are used which are absorbed internally by the plant.

Extensive use is being made of different fungicides both in treating the seeds before sowing and in combating various diseases of plants in the process of their growth. Among these are granosan, copper, trichlorphenolate, tetra-methylthiuram-disulphide, blue vitriol, etc.

The majority of the work connected with the struggle against pests and diseases of field crops and forests is carried out in the USSR with the help of tractor-drawn equipment, apparatus installed on trucks, or from the air. In orchards, vineyards and also truck gardens horse-drawn and hand-operated apparatus are used.

All poison chemicals are preliminary tested in the research institutes of the USSR Ministry of Public Health, which establishes the degree of their toxicity as well as the residual effect upon agricultural products of the poison chemicals used to treat the crops. On the basis of this research data, the USSR Ministry of Public Health has established the maximum permissible residual content of poison chemicals in different products. For instance, the presence of any quantity of DDT in grain or milk is absolutely prohibited. In seasonal products—fruit or vegetable—this chemical may be present within the limits of not more than 1 mg. to 1 kg. of the product. The maximum permissible content of hexachlorcyclohexane in food products has been established as from 1 to 1.5 mg. of the preparation to 1 kg. of the product.

The organs of the public health service determine the obligatory conditions as well as obligatory precautionary measures to be adhered to in using poison chemicals which present a danger to the health of human beings. Such chemicals include cyanic, phosphororganic and mercurorganic preparations. Nearly all the preparations used in the USSR to combat agricultural pests and diseases of plants are manufactured by Soviet industry. The only exceptions are some phosphororganic preparations as well as herbicides which are as yet produced in insufficient quantities in the USSR. There is also a certain shortage of seed treating preparations.

NEWS AND NOTES

Seed Treatment Aids Sesame

Seed treatments along with crop rotation may improve stands of sesame—a new, rapidly developing oil-seed crop for the United States.

Studies by USDA plant pathologist C. A. Thomas show seed treatment can result in a significant reduction of bacterial leaf spot, blight, damping off and other diseases.

Although sesame is one of the world's oldest oil and seed crops, little work has been done anywhere on the control of its diseases. In this country, poor stands caused by diseases are a major difficulty in the South-eastern States. Diseases are less troublesome in the Southwest.

Production of sesame for oil and seed is promising for farmers who operate under acreage restrictions of basic crops. Imports of this product—9 to 24 million pounds annually since World War II—account for about 90 per cent of our consumption. Large quantities of whole seed are used by bakers and confectioners.

The combined oil and protein content of sesame seed is probably greater than in any other edible seed or nut. The average is near 50 per cent oil and 25 per cent protein.

In disease studies of sesame on naturally infested soil in a greenhouse, untreated seed gave a stand of only 0.8 per cent, but seed from the same lot treated with protectants gave a 73 per cent stand. That is a 90-fold increase. Seeds used in both cases were over 94 per cent viable.

Results varied with concentration of protectant, but stands ran as high as 73 per cent on seed treated with captan, 63 per cent with thiram, and 52 per cent with chloranil.

In field tests with seed more than 96 per cent viable, the same chemicals gave stands of 34, 39, and 32 per cent respectively, compared with a 5 per cent stand with untreated seed.

One-fourth ounce of captan per bushel of seed was almost as effective as 2 ounces of the other chemicals. At present-day prices, material costs about 1 cent per acre. No toxicity to plants was observed at the most effective concentrations.

Volatile mercuries and several other treatments also were tested, but gave less effective control than captan, thiram, or chloranil.

In most cases, seed of the variety Kansas 10 represented the dehiscent varieties—those whose seed capsules burst open when dried. Seeds

of Dulce sesame and the indehiscent variety Delco were also used.

(Extract from *Agricultural Research*, U.S. Department of Agriculture, June 1959, p. 10).

Aerial Pest Control Operations in U.S.A.

The main aerial pest control programmes of the United States Department of Agriculture in 1957 were as follows :

	Acres
Gypsy Moth	2,902,507
Spruce Budworm	1,380,000
Grasshoppers	1,738,651
Mediterranean Fruitfly	400,000
Beet Leafhopper (Federal and State)	350,000
Miscellaneous	100,000

Gypsy Moth and Spruce Budworm projects averaged between 70 and 75 cents per acre for chemical and application. Grasshopper control costs were approximately 50 cents per acre for chemical and application. Prices for the actual flying varied from 35 cents to 8 cents per acre.

This year showed a decided increase in the amount of acres that had to be resprayed. It is felt by many applicators that the dosage of chemical prescribed is too low to obtain the desired insect control in all cases. The effectiveness of aerial spraying could be improved by more adequate surveys prior to the job starting and preparation of adequate maps to be followed for spraying. As the projects increase, this is becoming even more necessary for successful aerial spraying than it is now.

(Extract from *National Agricultural Chemicals Association News and Pesticide Review*, Washington, D.C., Vol. 16, No. 1, December, 1957.)

Spray Drift Damage

Modern selective weed-killers are a valuable aid to good farming—but not when they drift on to nearby susceptible crops. Any fine spray will drift with the natural movement of the air : it may fall on the next field or on a crop some distance away, causing damage which may not show for a fortnight.

If you can, spray when there is a reasonably steady wind blowing away from crops that may be harmed. Calm days can be safe, but the air is not often really still; there are always likely to be eddies. If a light wind is blowing in a dangerous direction, and you cannot wait until it changes, leave a wide space at the edge of your field,

to be sprayed when conditions are more favourable. Keep the spray-bar as near to its target as possible without upsetting the proper distribution of the spray, and whenever possible spray before any susceptible crops nearby have come through the soil.

If ever it should be absolutely essential to spray in windy weather or in exposed positions, downwind spraying gives slightly less drift than upwind or crosswind spraying, and a boom shield will help. But spraying should never be done in such conditions with dangerous materials like the dinitro compounds.

(Extract from *Agriculture*, London, Vol. 64, No. 12, March 1958, pp. 620-621.)

Rice Pests and Diseases in Japan

The rice crop in Japan, covering about three million hectares and producing nearly 9 million tons of rice annually, is attacked by about two hundred species of injurious insects. The annual loss due to these pests is estimated to be 140 thousand tons or 1.6% of the total rice production. As this estimate is only in respect of severely damaged fields, the total loss covering even slight damage is believed to be 5 to 10% of the total rice production.

The damage to rice crop by pests is becoming more severe as farming becomes more intensive and larger quantities of fertilizers are used in rice cultivation. Therefore any further increase in rice production without extension in the cultivated area, which is a very difficult task in Japan, can be accomplished only if due consideration is given to the control of pests.

Insect pests of rice crop in Japan are composed 42.3% of Hemiptera, 17.2% of Orthoptera, 15.8% of Lepidoptera, 12.3% of Coleoptera and 12.4% of other orders. 43.5% of them attack the leaves, 35.2% attack stems and sheaths, 11.2% attack the ears, 8.1% attack the roots while the remaining 2.0% cause mechanical disturbances.

The yield of rice in Japan is markedly depressed by diseases, the loss caused by them being about 300,000 tons per year, *i.e.*, 3.3% of the total yield, inspite of the efforts made to control them. The loss exceeds, not infrequently, 700,000 tons, *i.e.*, 8.8% of the total yield, when the diseases occur in an epidemic form. This loss would be double or even more, if control measures are not undertaken.

The diseases which cause such losses are blast, brown spot, bacterial leaf blight, stem and sheath blight. These are called the 'big five' of rice diseases in Japan.

(Abstracted from a pamphlet *Insects and Diseases of Rice Plants in Japan*, prepared by the National Institute of Agricultural Sciences, Japan, in connection with the Fourth Session of the International Rice Commission, FAO, 1954.)

Project for Plant Protection and Locust Control

A bilateral agreement under the Indo-U.S. Technical Co-operation Programme, for the supply of equipment and technicians for anti-locust work was signed in 1952 with the object of assisting in fighting the locust plague which commenced in India in 1949 and became alarming in 1952. Later, in view of the need to protect crops from the attacks of not only locusts but also from other pests and plant diseases, the scope of the project was broadened in February, 1953, as a result of which the materials and equipment received under the project could be utilised for general plant protection work when not required for locust control.

The estimated cost of the project is $5,90,218.36 and Rs. 13,28,000, the dollar expenditure being borne by the U.S. Government and the rupee expenditure by the Government of India. Materials and equipment worth $5,51,767.34 were received upto the 31st March, 1958. The services of three Piper Cub aeroplanes with the required number of crew under the charge of an Entomologist were made available for 3 to 4 months each year during 1952 and 1953 for locust control work in Rajasthan.

As there was very little locust activity during 1957-58, the power-operated equipment and the insecticides received under the project were not used for locust control. The vehicles, however, were used for locust surveys in the desert areas of India. Some application equipment, insecticides and vehicles were made use of in the States to assist in fighting large scale pest and disease outbreaks.

Plant Protection Committee for South-East Asia and the Pacific

The second meeting of the Plant Protection Committee for the South-East Asia and Pacific Region was held in Kandy, Ceylon, from 2nd to 7th December, 1957, and attended by representatives of twelve governments and the South Pacific Commission. From India, Dr. K. B. Lal, Plant Protection Adviser to the Government of India, attended the meeting.

The reports presented by government representatives about the plant quarantine activities in their respective territories indicated that the provisions of the regional Plant Protection Agreement and the recommendations of the previous sessions of the Committee had been widely implemented, specially those in relation to the measures for preventing the introduction into the region of the South American Leaf blight (*Dothidella ulei*) of Hevea rubber.

Appendix A of the Plant Protection Agreement, which contains a list of destructive pests and diseases not yet established in the region but requiring particular attention in quarantine enforcement, was revised and modified by the Committee in the light of the further information available on the distribution of important pests and diseases. The Committee recommended some measures for regulating

the importation and movement of crops of regional importance. Among these, it was recommended that bud wood and other propagating material of Hevea rubber moving within the region should be dusted with sulphur before shipment and dipped in a mercuric chloride solution for a brief period immediately before use to eliminate *Oidium heveae,* because of the possibility of physiologic races of the organism existing or developing in different areas of the region.

The Committee further emphasized the risks involved in the dissemination of the destructive pests and diseases by plant materials moving in international air traffic and suggested that, in addition to appropriate legislative control, a campaign for public education on this matter should be launched in each country.

FAO Desert Locust Control Committees

The Eighth Session of the FAO Technical Advisory Committee on Desert Locust Control, which convened at FAO headquarters from 10 to 13 June 1958, was attended by delegates from France, India, Iran, Pakistan, the United Arab Republic, the United Kingdom and the United States of America. Saudi Arabia and UNESCO were represented by observers and the director of the Anti-Locust Research Center attached as consultant. An important conclusion was that the over-all desert locust situation was more serious than in June 1957 and that there was no reason to expect any early abatement of the plague. Considerable attention was given to imposing the exchange of locust information and it was hoped that the newly established International Desert Locust Information Service would assist in this direction. The Committee noted that the joint FAO—UNESCO ecological survey of the main breeding areas of the desert locust had been initiated and that the first phase of the survey would be undertaken in the Sudan and Chad territory. The importance of developing and adopting enforced locust control techniques was emphasized as these and the use of insecticides at correct dosages should reduce the costs of anti-locust campaigns.

The subsequent fifth session of the FAO Desert Locust Control Committee, which met from 16 to 21 June, 1958, was attended by delegates from Ethiopia, France, India, Iran, Iraq, Italy (on behalf of Somalia), Libya, Morocco, Pakistan, Saudi Arabia, Spain, Tunisia, Turkey, the United Arab Republic, the United Kingdom and the United States of America. Of the many aspects of desert locust control discussed, the following were the salient :

1. Crop damage caused by the desert locust during the period 1949—1957 was estimated at US $42 million. It was concluded that the relative freedom of most countries from significant losses confirmed the value of the extensive anti-locust operations taken by so many governments in recent years.
2. To meet the rapid spread of the desert locust in the Near East in early 1958, FAO contributed emergency aid to the approximate value of US $123,000, the USA gave assistance to the

value of US $125,000, Iraq to the value of US $28,000 and the U.S.S.R. provided very substantial aid to the team. It was too early to estimate to what extent these outstanding examples of co-operation had curbed the further spread of the locust plague.

3. The cost of the 1957/58 international anti-locust campaign in the Arabian Peninsula, in which missions from seven governments participated and to which many other governments contributed, was estimated at U.S. $1,350,000. It was concluded, however, that the campaign had been inadequate to prevent the formation of a considerable number of new swarms.
4. The 1958-59 campaign was planned at an estimated cost of US $1.2 million. The foreseeable contribution from governments and FAO left an estimated deficit of U.S. $225,000. The Director General of FAO was requested to discuss with governments that this deficit might be covered.
5. Emphasis was placed upon the need to reorganize further Arabian campaigns, particularly as regards stabilizing the budget through an agreed scale of contributions, the adoption of a single command and increased flexibility.
6. The recent spread of locust swarms from eastern Africa had again stressed the strategic importance of the Somali Peninsula, and the manner in which FAO might strengthen anti-locust efforts in that area, particularly in Somalia, prior to that territory's independence in 1960, was discussed. The Governments of France and the United Kingdom pledged contributions of the value of U.S. $35,000.
7. Agreement was reached between France and the Arab States in north-western Africa regarding the role of FAO in assisting to build up intergovernmental co-operation.
8. Five governments pledged financial contributions to assist FAO's program on the development of a long-term presentation policy of desert locust control.

(Reproduced from *FAO Plant Protection Bulletin,* Vol. VI, No. 11. August, 1958).

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BOOK REVIEWS

Hand-Book of Tropical Crop Diseases, by M. N. Kamath, Prakash Publishing House, Poona, 1958, First Edition, 84 pages, 4 plates of illustrations, 17 text-figures, 2 appendices and an index to crop plants. Price not indicated on the Hand-Book but mentioned in a hand bill as Rs. 2.50 or 5 sh.

The author has published two other books on plant diseases, the first in 1953, price Rs. 12, and the second in 1956, price Rs. 10. According to him, these two books and the present Hand-Book 'have been highly commended' by some eminent plant pathologists as well as by 'many others too numerous to mention'. The first 26 pages of the Hand-Book deal with the nature, classification, symptoms and economic importance of plant diseases, the modes of their spread and the principles of their control and the subsequent 48 pages provide tabulated information on crop diseases under five heads.

Although the Hand-Book is said to deal with 'Tropical Crop Diseases' and the Introduction suggests by implication that it is intended for 'the education of our agricultural officers working in research, extension and plant protection lines' all over India, the subject is treated mainly with reference to the region roughly covered by the old Bombay State. Some crop diseases, occurring even in tropical India, are not mentioned and neither are the diseases of sesamum, onion and cashewnut, which are also grown in south India. On the other hand, 'swollen shoot' of cacao, a virus disease not known to occur in India at all, though known from Ceylon, is included. The identity of the sugarcane virus disease, 'ratoon stunt', is not yet established in India and, therefore, its inclusion in the Hand-Book can be misleading. Under 'Forest Trees', a disease of silver oak is mentioned (page 73) but economically the far more important, tropical sandal tree, with its famous spike disease in south India, is omitted. The author should have done well to define in his introduction the geographical scope of the Hand-Book.

The author has classified plant diseases into those of parasitic, non-parasitic and virus in nature. Parasitic diseases have been said to be infectious and caused by living agents, which are mentioned as fungi, bacteria, nematodes and protozoa. While several examples of the first three, living agents have been given and listed, no example of any diseases, caused by protozoa, has been cited, although the latter have been stated to be 'causing damage to crops'. However, it should have been correct to state that no crop disease of any consequence in India and only a very few in the world are known to be

caused by protozoa. Nothing has been said about the non-parasitic diseases, except that they 'are non-infectious' although they are well known in India, being caused mostly by deficiencies of trace elements in the soil, and can be controlled by making good the deficiencies. Viruses may constitute a stage between the living and the non-living but they are not 'of intermediate nature' in so far as their infective property is concerned. Indeed, not only is the highly infectious nature of virus diseases in plants, animals and men well established, it is not even exactly comparable to the infections in plants produced by living agents. The modes of spread and symptoms of plant diseases have been well described.

The author's view that spraying and dusting of crops with fungicides 'are prohibitive in cost and can only be recommended in money crops like cotton, betelvine, arecanut, fruit trees, . . . and have no place in the usual grain and vegetable crops' is loosely expressed and only partially correct because potato and many other vegetable crops are economically treated with fungicides. Indeed, the author himself has recommended such treatment (pages 44—49) on *bhendi* (lady's finger), brinjal, carrot, cucurbits, tomato and other crops. Even for wheat rust he has recommended dusting with sulphur (page 81), although this method is neither feasible nor economical except on small, experimental crops. The same objection has been repeated on page 11 and yet the author has included (page 12—14) some details of soil applications of chemicals to control soil-borne diseases, which method, though practised in some countries, has not been much in use in India so far for a variety of reasons. In any case, the use of methyl bromide for soil fumigation at the rate of 200 lbs. per acre (page 13) would cost about Rs. 1,300 per acre for the chemical alone and no body would think of it. Even Killoptera, mentioned as an alternative fumigant, would cost about Rs. 375 per acre. Incidentally, Killoptera is an old and discarded trade name, though the chemical is still available as a mixture of ethylene dichloride and carbon tetrachloride, used for the fumigation of grain stocks and godowns against insect pests.

The 'Classified List of Diseases' (pages 29—76) is useful, giving as it does the name of the disease, the scientific name of its causal agent, its nature, which is mostly wrongly indicated by mode of transmission, diagnostic symptoms and measures of control. However, the list suffers from several defects. The nature of a disease is generally indicated by its causal agent but modes of transmission are given under the heading 'Nature of Disease'. This arrangement has landed the author in the absurd situation of calling the 'twisted top' of sugarcane a physiological disease under 'Causal Agent' and in the very next column under 'Nature of Disease' stating that the nature is 'not known' (page 34). Tomato plant is not known to suffer from any virus disease known as 'bunchy top' any where in the world, though it is attacked by a virus disease known as 'leaf curl' in India and elsewhere. DDT has nothing to do with the control of mango mildew (page 65).

Spraying oats seed with formaldehyde (page 31) is an obsolete remedy. Some recommended fungicides, *e.g.*, Perenox and Nomersan, have long gone out of the market. Trade names of chemicals, used in plant protection, are best avoided because the same chemical is marketed under different trade names by different commercial firms, unless all such names are given or there are strong reasons for recommending any one of them and not the others. For this reason, government publications in India usually refer to the chemicals by their general, technical names and, while the author is under no such limitation, he might well have followed the sound, government practice. However, foreign books and publications have often mentioned trade names of plant protection chemicals. It is theoretically correct and even tempting to recommend the growing of resistant varieties, as the author has done in many cases, to avoid or withstand disease attacks but unless suitable resistant varieties have been evolved and are available, the recommendation is more conventional than helpful.

The Hand-Book contains many incorrect statements and loose expressions. Plant disease may be a 'complex biological phenomenon' but it is certainly not *only* 'the result of interaction among the host (plant), the pathogen and the environment' (page 1), because many diseases can appear where no pathogens are involved. Not only 'all micro-organisms' but all organisms 'are either plants or animals' (page 2). 'Steam or heat' cannot be regarded as a fungicide, which is also not necessarily 'not phytocidal' (p. 12). Much depends on how it is prepared and used. A fungicide is not a fungicide if it is not 'fungicidal in effect' (page 12).

There are quite a large number of printing mistakes of spelling on about a dozen pages. Penicillin, deficiency, formulae, stirrup, aeroplane, orient, etc., etc., have been wrongly spelt. On page 16, the formula for Bordeaux mixture is given as 5-5-50 but the illustrative figures on page 17 show it to be 4-4-50, a discrepancy which has arisen because the figures have been reproduced from some book or paper without the necessary explanation.

The 'Index to Crop Plants' (pages 82—84) is a useful feature of the Hand-Book.

K. B. Lal

The Principles of Biological Control, by Harvey L. Sweetman, Wm. C. Brown Company, Dubuque, Iowa, U.S.A., 1958, 560 p. Price not indicated.

This is a completely revised and enlarged edition of an earlier work, *The Biological Control of Insects*, by the same author, published in 1936. During the past 25 years or so, a large volume of literature on various natural enemies of insect and other pests, dealing with their life-history, habits, the methods of their handling and utilisation and

other aspects having a direct or indirect bearing on biological control of pests, has appeared, which lies widely scattered in various publications, reports and other records. No attempt has been made to critically analyse and assess the accumulated information and to review it and make it available in one place, as has now been done by the author. The present edition, therefore, meets a definite need and will serve as a valuable reference book being, as pointed out in the author's preface, "the only available source covering the broad field of biological control of plants and animals."

The book is divided into fifteen chapters and follows more or less the same pattern of presentation of the subject matter as its precursor. The theoretical basis of biological control and the use of resistant hosts are dealt with in the first and second chapters respectively. Each of the following eight chapters is devoted to a particular group of organisms with special reference to their utilisation in the field of biological control. Of these, the disease-causing bacteria, fungi, viruses and protozoa are discussed in four chapters while the remaining four chapters deal with parasitic and predatory invertebrate animals. Quite understandably, the parasitic and predatory insects (Hexapoda), which are treated in three chapters, have received the maximum space allotted to any single group of organisms. Some biological relations of beneficial insects to their hosts and prey and the handling of beneficial insects are discussed in the next two chapters. Chapter XIII deals with five major groups of predatory vertebrate animals. A list of 80 instances of successful biological control of animal pests in different parts of the world, with some supporting evidence, is presented in the following chapter, which discusses the evaluation and results of biological control against animals. Similarly, some examples of successful biological control of plant pests are mentioned in the last chapter, following a general discussion of the subject.

The book contains a wealth of useful information and a comprehensive bibliography of 49 pages, in which the references are listed alphabetically and arranged by chapters. There is a combined author and subject index.

T. SANKARAN

Advances in Pest Control Research, edited by R.L. Metcalf, Interscience Publishers, New York, Vols. I and II, Price $12.50 per volume.

Advances in Pest Control Research is a serial publication, the first volume of which was brought out in 1957 and the second in 1958. Further volumes in the series are expected to follow annually. Each volume would carry comprehensive, critical reviews, contributed by specialists, of new concepts and recent developments relating to different aspects of pest control, with emphasis on the fundamental

aspects. Some idea of the wide scope of the reviews and the range of subjects covered in this series can be gained from the contents of the two volumes which have appeared.

Volume I runs to 514 pages, excluding the title page, preface and table of contents, and carries ten articles. Two of the articles relate to chemical analysis and bioassay of pesticide residues. The chemistry and mode of action of herbicides and organic phosphorus insecticides are discussed in two separate reviews. The remaining articles relate to : control of health hazards associated with the use of pesticides; use of radioisotopes in pesticide research; mechanisms of fungitoxicity; recent advances in the control of soil fungi; repellents for biting arthropods; and the status of systemic insecticides in pest control practices.

Volume II, which has 426 pages, comprises eight reviews on the following subjects : the fluid kinetics of application of pesticidal chemicals; innate toxicity of fungicides; research advances in seed and soil treatment with systemic and non-systemic (printed in the table of contents on page vii as 'systematic and non-systematic') insecticides; isotope dilution techniques for the determination of pesticide residues; wool digestion and moth-proofing; the relation of chemical structure to activity for the 2,4-D type herbicide and plant growth regulator; chemical structure and activity of DDT analogues with special consideration of their spatial structures; and the spread of insecticide resistance in pest species.

At the end of each article is a list of references cited in the text. The texts of some of the articles are supplemented with tables, charts, drawings and photographs. Each of the two volumes has a subject index and there is a cumulative title index for both at the end of Volume II.

T. SANKARAN

Potato in West Bengal, by H. C. Choudhuri, Government of West Bengal, Calcutta, 1957(?), 125 p., illustrated, Rs. 6.00 or 9s. 9d.

This book deals with the various aspects of potato cultivation in West Bengal, particularly the methods of cultivation, potato varieties grown in West Bengal, storage and marketing of potatoes. A considerable portion of the book is devoted to the descriptions of insect pests and diseases associated with potatoes, both in the field and in storage, and their control, and also methods of preparation of insecticide and fungicide sprays.

Among others, the golden nematode (*Heterodera rostochiensis*) and the bacterial ring rot fungus (*Corynebacterium sepedonicum*) have been mentioned to attack potato. But these are not known to occur in India.

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